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OF

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The
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December, 1932

EDITORIAL

CHANGES IN THE AGRICULTURAL DEPARTMENT

WITH the passing of the present year several changes of considerable import in the organisation of the Agricultural Department have come into being. The old method of reporting plant pests and taking remedial or preventive measures against them through the means of a staff of three inspectors assisted by a number of sub-inspectors has been abolished. The six Divisional Agricultural Officers and their entire staff of Agricutural Instructors are now responsible for the well-being of the territory under them and its protection from the ravages of plant pests. They have to report the presence of any pestilence to the Controller of Plant Pests at Peradeniya who takes the place of the now obsolete three Plant Pest Inspectors. This officer will immediately advise as to what action should be taken to bring or keep the enemy under control. He will also act as the central recording officer for all such work and he and his staff will personally appear on the spot in cases of serious outbreaks or epidemics. He will no doubt find himself very fully occupied. With an experienced officer in charge the new system should work as efficiently as the old and has the advantage of being one centralised organisation but at the same time capable of extending control into all the divisions to an even larger extent than before.

Another important change is the passing of the Central Experiment Station, Peradeniya into that of the School Farm. That there was need for the youth of Ceylon who prosecuted their studies at Peradeniya to have more broad acres upon which to work with their own hands there is no gainsaying and to this purpose the Experiment Station has now been assigned. It does not mean that its usefulness as an Experiment Station will entirely cease. Indeed the elaboration of new strains of crops suited to this Island by hybridisation and selection and the acclimatisation of introductions must be pushed forward with the utmost energy and these lines of work can be carried out on the School Farm without in any way interfering with its usefulness as such. The agricultural development of Ceylon can only be achieved by the pursuit and solution of many fundamental problems that await enquiry on every hand. A fact that is not sufficiently realised is that many of our problems are unique, especially the problems of vegetation on our acid soils with such varying environments due to differences of altitude. The findings of experiment in other lands do not necessarily afford to us that assistance which they do to many others. The need for experimentation in a time of depression is greater than at any other time.

The creation of a post of Propaganda Officer especially for carrying educative propaganda into the villages is another of the Departmental innovations and it is certainly to be hoped it will not be the least useful of the new order of things.

THE CULTIVATION OF FRUITS IN CEYLON WITH CULTURAL DETAILS—VII

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GROUP B

SOME FURTHER FRUITS FOR THE LOW-COUNTRY, DRY AND SEMI-DRY ZONES (PREFERABLY UNDER IRRIGATION)

(4) POMEGRANATE (*Punica Granatum*) known also as the Carthaginian apple and locally as the Delun, S. and Madalan Kai, T. This is a fruit of very ancient history and in early days must have been of some considerable standing since history connects this fruit with the Orange, Grape and the Fig. Much cannot be said, however, of the present day varieties, and although it is now grown in most tropical and sub-tropical regions it has degenerated to a very poor type and more or less is only used for ornamental purposes only. For these reasons it is doubtful if it should be included for consideration in our list.

America is however reported by selection of material and care in cultivation to have obtained good varieties.

The present degenerate type is partly accounted for in that the habit of the pomegranate is to form numerous shoots from the base of the plant and it is contended that these withdraw tht nutriment that should go to the fruit bearing stems. It can well be imagined therefore that should the tree be left to take a natural form, and not pruned at regular intervals, degeneration must naturally and very soon follow.

Though the tree grows so well in very hot and arid regions it is not strictly tropical, its home being Persia and along the Mediterranean regions of North Africa and South Europe. Its present distribution over so many parts of the globe shows the adaptability of this ancient fruit, and Florida now grows this commercially for export to North American markets.

There are numerous varieties of which few can be considered worth cultivating, that mostly in favour in California being the "Wonderful" a large fruit 5 inches in diameter, deep purple in appearance with very juicy flesh, deep red to crimson in colour and of grape like flavour. An Indian variety "Bedana" a Kabul

form of large size, very sweet and almost seedless is also recorded which, after the Ceylon variety with its enormous quantity of seed, infers considerable improvement. Other varieties grown are "Spanish Ruby", "Rhoda", and "Paper Shell".

The pomegranate attains the size of a large shrub or small tree of approximately 15 feet as a rule and is usually found planted here and there near the sea coast of the wet zone and generally throughout the dry and semi-dry zones of Ceylon. The best fruits are obtainable under very arid conditions where high temperatures are the rule during its fruiting season and the soil is not too light, a deep loamy soil being preferable with a fairly high water table.

The plant is raised easily from seed, but propagation by vegetative means is more dependable for preserving good varieties. Since the plant suckers freely these should be used for raising stock and the suckers must in any case be removed from the base of the tree at regular intervals. Hard wood cuttings is another method, the cuttings being 10 to 12 inches in length and a quarter to a half inch in diameter. These should be inserted in prepared beds of a sandy nature at 9 to 10 inches apart in rows and can be transplanted direct to permanent sites at from 12 to 15 months from insertion of cuttings. They should fruit in approximately two years from planting.

Planting distances in Ceylon need not exceed 15 ft. by 15 ft. good holes being afforded the trees to which a proportion of good cattle manure has been well mixed with the soil in the refilling of holes. Water and shade are essential until the plants become established after which the plant will stand full exposure. Irrigation facilities are an advantage and the surface soil should be kept free from weeds, and an occasional stirring during the growing season is also beneficial.

Pruning is important and is required as the tree makes growth with a view to the formation of a round shaped head and a balanced structure, and for the first few years this should be carefully attended to by shortening elongated growths and the thinning out of congested growth. A standard form should be aimed at with 4 to 5 well shaped branches at 3 feet from ground, the branches being allowed sufficient lateral growth to fill, but not to crowd the intervening spaces, suckers of the root must be removed at regular intervals otherwise these adversely affect the fruiting properties of the tree.

(5) CASHEW NUT (*Anacardium occidentale*).—This tree, the Caju gaha, S. or Mundiri-maram, T. needs no description to the villager of the low-country wet and dry zones but the many uses of the fruit and nut and the present demand for the latter is far from being realised locally.

The fleshy heart-shaped receptacle which bears the nut has its uses but it is the latter that is more generally in demand. This receptacle, really the swollen peduncle and disc, which is 3 inches or so in thickness is often termed the cashew apple and is very fleshy and juicy and often eaten raw, or the juice can be expressed from the apple and used for flavouring. In its South American home the juice is expressed and fermented with sugar to supply both a wine and a refreshing beverage known as "Cajuade".

The cashew nut is kidney shaped and roughly 1 inch in length and the kernel of the nut has a variety of uses, being edible, and when roasted much appreciated for dessert. It is exported from India to North America in large quantities where it is utilised in confectionery and for table purposes. The oil expressed from the kernel of the nut has its possible uses whilst the tree exudes a gum which can be used as substitute for gum arabic.

The tree is indigenous to Tropical America and is found as a semi-naturalised tree practically throughout the tropics. It is particularly adapted to the coastal regions of both wet and dry zones but more commonly in the latter and will also grow up to 3,000 feet elevation. It is very ragged in growth forming a wide spreading tree of 40 feet or so in height, and can be grown in almost any soil but seems to prefer localities with soil of a porous sandy nature. Young plants can be raised by sowing either *in situ*, or preferably by sowing the seed singly in bamboo pots. Germination is rapid and the seedlings can be planted out to permanent quarters within 9 to 12 months from sowing. The first few fruits can be expected at 3 or 4 years of age and crops increase annually till the trees reach maturity, at approximately fifteen years of age, at which stage gumming of the stem sometimes affects the health of the tree in the low-country though this does not occur in all localities.

The fruiting season in Ceylon varies according to locality and elevation but nuts are usually available in large quantities from March to May. There is a wide market for prepared kernels outside Ceylon and considering this tree is so very hardy and vigorous within its range of cultivation, often growing in places where no other crop can be produced, it is remarkable that Ceylon has not hitherto taken a large share in the market production. As a remunerative proposition it is well worth attention.

At the present moment South India commands the market in the export of the kernels to American ports and is able to dispose of its own produce together with that received from East African ports. The large tracks of waste land in the dry zone

of this Island in which the cashew would flourish if planted up should, in combination with the produce of the large number of trees at present found wild, afford sufficient for a market of its own and warrant the erection of shelling and cleaning machinery. The shipment of the kernels present few difficulties with the facilities now in vogue by means of tins of 25 lb. capacity treated with carbon-dioxide and hermetically sealed. Large supplies of the seedlings are available at the Heneratgoda Gardens at the moment and such can be maintained if the demands warrant this.

(6) JUJUBE (*Zizyphus Jujuba*).—Known in most part of the tropics as the common Jujube and locally as the Masan, S. and Illantai, T. The present varieties of the Ceylon species are unfortunately with few exceptions, much inferior to the large fruited variety cultivated in China where the Jujube is considered one of the principal fruits, and in parts of India where many improved varieties of this fruit are in cultivation.

It is normally a small thorny tree with a spreading head found wild in the dry regions of Ceylon and as such has received scant attention as a fruit tree, nor is it probable that much can be made of the present varieties of the Ceylon species. India however has devoted some attention to this and possesses superior varieties of which some have in the past been obtained for local distribution. The garden possesses such a one and though owing to elevation and rainfall the tree rarely fruits, the quality is undoubtedly a good one.

The species has numerous varieties the best of which produce fruit two inches and over in diameter and thrives under both tropical and sub-tropical conditions where dry conditions prevail. It grows on moist soils, taking exception only to very heavy wet soils, and under the most dry conditions requires little or no irrigation. The fruits are used in various ways, the best varieties as a dessert fruit, and in confectionery as a sweetmeat, and are also in the unripe state, preserved and dried for uses similar to the date. They are dry and wrinkled when fully ripe but possess a very pleasing sub-acid flavour and are used in the preparation of tablets and syrup for throat troubles. The tree grows rapidly and affords heavy crops and if planted under orchard conditions spacing at least 20 ft. by 20 ft. is required.

Propagation is usually by seed but vegetative reproduction by means of suckers or cuttings, gootees or layers is also successful. Budding and grafting has not to date been tried in Ceylon but the wild tree should prove a useful stock on which to bud the better varieties.

The seeds are hard and require assistance in germination by either filing the end or cracking the seed coat, otherwise the seed takes a very long time to germinate. In the seedling stage growth is rapid and transplanting can be made to permanent positions when they attain six to eight inches in height. The fruiting stage is normally reached in 3 to 4 years though year old seedlings have been known to yield a little fruit.

The tree is worthy of much more attention than that given it in the past and where a good variety is established it should be perpetuated from root suckers, these usually being readily available. So robust is it, that it will stand the maximum heat, the poorest soil, exposure to wind and probably the least cultivation of any fruit tree, but it does appear to dislike any wet soil or climate.

The Indian varieties are well suited to the dry zone proper whilst the Chinese varieties would thrive in the dry and semi-dry intermediate zones.

In addition to the above fruits suited to the dry and semi-dry zone there are others of minor importance in the horticultural sense, that is, though not generally considered as dessert fruits, they have nevertheless some importance when used for the preparation of jam, jellies and preserves, etc. Many of this type are indigenous or old established fruits to which little or no attention has been given and which remain in a wild or degenerated condition but which with selection and cultivation could doubtless be much improved. These include the Bael fruit which is well noted for its medicinal properties, the Ambarella and Nelli, so appreciated as a preserve; the Mammea or Mammy apple considered a good fruit when stewed or preserved with sugar; the Wood apple or Diwul, S. used for cooling drinks, for preserves and in medicine; Velvet Tamarind or Gal-siyambala, S. used in the preparation of chutneys and the Maha-Karande, S. used for tarts and jellies.

Of more recent introduction is the Mesquit bean or Algaroba with edible succulent pods, and the Natal Plum used for tarts and in the superior varieties, quite an edible fruit, both of which are worth persevering with.

A CHANGE-OVER EXPERIMENT IN RUBBER TAPPING

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INTRODUCTORY

THE experiment here described was started on the Experiment Station, Peradeniya on April 1st, 1926. 384 trees were used and these were divided into 24 plots of 16 trees each. In eight of the plots the cut was not changed over until the end of the panel was reached in three years, in eight plots the cut was changed over annually on April 1st and in the remaining eight plots the cut was changed over every six months, on April 1st, and October 1st.

It is a widely held theory that changing over the tapping cut results in better bark renewal, and it was mainly to test the correctness of this theory that this experiment was started. A system was worked out for the periodical measurement of the thickness of the renewed bark when this bark was one year old in each case. Three such measurements were taken in each treatment, and on each occasion an additional measurement of the untapped bark at two feet from the ground was made. The final criterion of bark renewal was taken to be the percentage which the average thickness of renewed bark formed of the average thickness of the untapped bark in the same plot.

Separate records of the yield of dry rubber from each plot were maintained—in this case no comparison could be made till the end of the six year period, since during that period the cuts in the three different treatments were at different heights from the ground.

BARK RENEWAL

Table I shows the average thickness of renewed bark in millimetres one year after the bark at that point has been tapped together with the average thickness of the untapped bark at two feet from the ground and the former figure expressed as a percentage of the latter.

Table 1

BARK RENEWAL MEASUREMENTS

Average of all Plots

	No Change-over			Change-over once yearly			Change-over once in six months.		
	Thickness of renewed bark	Thickness of untapped bark	Thickness of renewed bark expressed as percentage of untapped bark	Thickness of renewed bark	Thickness of untapped bark	Thickness of renewed bark expressed as percentage of untapped bark	Thickness of renewed bark	Thickness of untapped bark	Thickness of renewed bark expressed as percentage of untapped bark
	mm.	mm.		mm.	mm.		mm.	mm.	
1st Measurement	4.77	6.96	68.5	4.37	6.77	64.5	5.44	9.16	59.3
2nd Measurement	5.79	8.38	69.0	5.60	8.78	63.7	4.72	8.80	53.6
3rd Measurement	5.83	8.33	70.0	4.97	9.19	54.0	6.00	9.69	61.9
Average of 3 measurements	5.46	7.89	69.1	4.98	8.24	60.7	5.38	9.22	58.4

It must be borne in mind that the accurate measurement of bark thickness is not very easy, but in view of the fairly large number of trees employed the averages can be accepted with fair confidence.

It is apparent that even in actual average thickness of renewed bark the no-change-over plots are slightly superior to either of the others, and when these figures are expressed as percentages of untapped bark the superiority is increased.

The results of this experiment, therefore, do not in any way support the theory that changing over the cut once or twice a year results in better bark renewal.

The differences in average bark thickness are small and the figures probably indicate that the different treatments have not affected bark renewal one way or the other.

YIELD

Table 2 gives the average yields per tree for the three treatments for each year.

Over the whole period the change-over-once-yearly treatment has given the highest yield while the change-over-twice-yearly treatment comes second. The differences however are so small that it is doubtful if much significance can be attached to them.

Table 2

Average yields of dry rubber per tree

	No Change-over	Change-over once yearly	Change-over once in six months
	lb.	lb.	lb.
1926-27	5·29	5·26	4·76
1927-28	4·72	4·85	4·51
1928-29	4·68	4·62	4·48
1929-30	5·13	5·38	5·20
1930-31	6·24	6·47	6·88
1931-32	7·17	7·96	7·81
Total	33·23	34·54	33·64

SUMMARY AND CONCLUSIONS

1. An experiment was carried out with the main object of comparing the bark renewal on rubber trees on which (1) the tapping cut was not changed over till the end of the panel was reached in three years, (2) the cut was changed over once a year, (3) the cut was changed over once in six months. Separate yield records were also maintained.

2. It was found that the bark renewal measurement figures obtained in the experiment gave no support to the theory that changing over the cut resulted in better bark renewal. The highest average figure for thickness of renewed bark was obtained in the no-change-over plots. The differences are small and it may be assumed that the different treatments have not influenced the rate of bark renewal.

3. Changing over the cut has not resulted in any loss of yield. The highest yield was obtained from the change-over-once-yearly plots but it is doubtful if this superiority is due to the treatment.

THE PRESENT POSITION OF COCONUT CULTIVATION AS AN AGRICULTURAL ASSET OF CEYLON AND THE EXTENT TO WHICH IT MAY BE ADVANCED THROUGH THE GROWING OF BYE-PRODUCTS SIDE BY SIDE OF THE MAIN INDUSTRY

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ON many previous occasions, at the meetings of the Board of Agriculture and at the Conferences of Agriculture at Peradeniya, it was my privilege to discuss many matters connected with bye-products that may be profitably grown in estates, where the principal item of agricultural enterprise is coconut cultivation. On these occasions I referred to the scope there existed for carrying on animal husbandry with success, as well as the development of Robusta Coffee and fruit cultivation in coconut estates.

During the last ten years there has been a great awakening as to the diminution of crops in tea and rubber estates by continued cropping, and by soil erosion due especially to the tradition of clean weeding on steep hilly country. To stem the tide of this deterioration planters have put in a good deal of work by experimenting with the growing of leguminous plants in tea and rubber estates. I need not dwell on this subject as it is not germane to the thesis which I wish to advance on this occasion.

This movement of growing green manure crops, chiefly from seeds imported from Java and elsewhere, has been slavishly followed even by some coconut planters. This practice seems to me to be not only unnecessary but redundant. In the first place coconut estates as established for over hundreds of years, generally contain grass and the creeping desmodium between the palms. Therefore, there is little or no soil erosion. On the other hand the grass and desmodium growing together, form an excellent symbiosis, whereby the soil is aerated, atmospheric nitrogen is fixed, and the humus content and the moisture retaining capacity of the surface soil are greatly enhanced. Except in the case of hard cabook, or stony or hard clayey soils, the growing of grass and desmodium helps the palms considerably

not only to flourish, but to add to the crop yield as well. The policy then of trying to establish Calapogonium or Boga, or similar plants by weeding away the grass and desmodium, is worse than carrying coals to Newcastle. Although these points were well known to many coconut planters the actual extent and the nature of changes effected in the soil, had not been reduced to a mathematical investigation, nor were the chemical effects explored, and the economic results estimated from the point of view of the economics of Agriculture, as applied to coconut growing. As regards green manuring in coconut cultivation, I will proceed to give my personal experiences in various parts of the moist zone, in such areas as the Chilaw, Negombo, Colombo and the southern half of the Kurunegala district. In the Pitigal Korale South my experience has extended to over 32 years. On an estate in this district I was able to establish *Crotalaria striata* throughout the whole estate with grass and desmodium. I plough in the green stuff here, once a year and I manure the palms once in two years. As the herbage kept on increasing considerably on this treatment, samples of the Crotalaria grass and desmodium were sent for a chemical analysis, when to my surprise the results of the analysis disclosed that the dried green manure and grass, gave as its nitrogen content over 3 per cent. As I was at the time applying 8 lb. of castor cake as my nitrogeneous fertiliser to each coconut tree it was obvious that the whole of it might be saved by applying 40 lb. of green stuff to each palm. This quantity I was able to obtain once in two years very easily and ever since then the practice of artificial manuring is as follows: Once a year the herbage is ploughed in, once in two years 40 lb. of green manure with phosphates and a little quantity of potash are applied to each palm. The application of phosphates is divided between the palms, and the pasturage and in addition a certain quantity of slaked lime is broadcasted between the palms together with half the amount of phosphates allowed to each palm. The results have been uniformly good and the estate is in good heart and yields crops at least 40 per cent. higher than what it yielded before the green manure system was adopted.

As the Crotalaria has established itself all over the estate, there is little pasturage, but this amount is sufficient for the estate transport and plough animals. The advantages of Crotalaria are that once established it regenerates itself after ploughing. It yields a large quantity of green stuff, and the plant is exceptionally free from pests. On the other hand it grows vigorously only in sandy loams, but in harder soils and in clays it dies out during the drought and its yield of green stuff is scanty. As a matter of fact Crotalaria has been a success in only one of my estates.

Elsewhere the practice has been entirely on different lines and has resulted in larger profits in bye-products than with Crotalaria. As a typical specimen of this practice results obtained at Kowlwewa Estate in the Katugampola Hatpattu may be stated as follows, viz:

The main policy here is the attempt to grow pasturage for cattle between the palms. For this purpose the land is ploughed and harrowed once in two years in sections. One-fourth of the estate is ploughed and manured every half year so that the whole estate is gone over in two years. Three cwt. of basic slag or Ephosphosphates, and three cwt. of slaked lime are applied to each acre. The phosphates are divided. One half is applied to each tree with 40 lb. of green manure the other half of phosphates is broadcasted with lime between the palms. With this treatment, the pasturage improves year by year, and its capacity of carrying cattle or other animals is proportionately increased. In my experience on estates where this practice has been followed, in two or three years the amount of pasturage will more than double itself, and areas which at first carried only one head of cattle for every two acres may be so enriched that every acre may carry two heads of cattle. With such a practice it was found that the growing of perennial leguminous trees such as *Gliricidia* and *Leucaena* or both was the best means of giving the necessary green manure to the palms. They can be grown all round the boundaries of the estates and on each side of the roads necessary for internal transport. The pasturage, however, is put through the animal body and is applied to the palms as fresh farmyard manure with 40 lb. of green leaves. I may mention here that close cropping of pasturage with cattle grazing in the open, yields a fodder of high nitrogen content and when passed through the animal at least 75 per cent. of the pasturage eaten, goes to the soil. It seems to me that the policy of not rearing animals on a coconut estate and looking after the pasturage which is there already, is throwing away ready made element for the coconut palm whose nut yielding capacity will thereby continually advance. In this connection I may state that basic slag or such phosphatic fertilisers with slaked lime, the cost of artificial manuring, and its application will not cost more than seven or eight rupees per acre per annum. This cost is returned tenfold every year after the first, in the increased nut yield.

So far, I have only alluded to the profits resulting by this practice as a primary product, but as regards the profits obtainable by the development and exploitation of bye-products it is obvious that the profits that emerge, will vary with varying circumstances such as the nature of the bye-products, the soil and weather conditions of the area in which these products are

produced, and the intensity of cultivation with which the grower deals with the products. All these items will effect the profit, so that it is not worth while here to state the results obtained by any individual, working in a particluar district or area. As regards animal husbandry I may mention that I have had experience of over eleven years in more than one estate with the breeding of Friesian cattle, both crossed and pure in the low-country. These herds are grazed in the open and are housed only in very wet and damp weather. The results obtained are excellent. They have exceeded by far our original expectations. Estates which at first carried only one head of these cattle per two acres, are now able to carry two heads for one acre. On this basis the profits from rearing such cattle may amount to more than fifty rupees per acre per annum, once a herd has been established and high class dairy cows and good cart bulls are produced. But even with Indian herds or with more quickly growing animals like sheep and goats, a good profit can be realised. Fruit growing is even more profitable, but it is only on a small section of the estate that fruit can be grown with profit.

In cattle rearing I was so surprised at the large improvement in the quality and quantity of the pasture after a few years of its development that I sent some samples of the pasture as eaten by the cattle to the Agricultural Chemist at Peradeniya for analysis. Mr. Joachim was good enough to analyse the samples for me, the results of which have already been published in *The Tropical Agriculturist*. Without going into details of the analysis I may state that it disclosed that the pasturage when dried, was equal in quality and chemical contents, to the best type of English hay, with a nitrogen content of over 3 per cent. The actual yield of pasture from each acre, therefore, became a matter of paramount importance, not only for coconut planters, but for all agriculturists in the low-country of Ceylon. From actual records of the yields in three of my estates, I find that the pasturage in the green state in terms of hay amounts to over two tons per acre, even when the land is only able to carry one head of cattle in good condition for each acre. The results I have mentioned are really astounding because hay has a definite value in the international market of agricultural produce. In a recent number of the "Farmer and Stockbreeder" I find that second quality hay commands £3 per ton in the market of the United Kingdom and of the north of Europe. If Ceylon can grow hay to the value of Rs. 80/- i.e. two tons at £3 per ton, we will have gone very far to solve most of the agricultural troubles we have had to face during the recent years of depression. The possibilities in store for us if once we realize that hay can be grown over a great part of this Island in such quantity and

quality, are immense. I bring these data and observations before you in the hope that some of you at least will work out this problem of growing hay from pasturage, not only amidst coconuts, but elsewhere as well; and in this manner confirm or disprove the results I have stated.

I hope that the Peradeniya experts in Agriculture will undertake experiments in growing hay in more than one district and in this way help those who are anxious to develop animal husbandry in this country. In these experimental stations when located outside the coconut belt, in the dry zone for example, an attempt may be made to grow pasturage between leguminous plants such as Gliricidia and Leucaena. In plantations growing Sisal or Kapok or timber of comparatively quick growth, such as teak and mahogany, the growing of hay may be tried. Gliricidia and Leucaena are both plants belonging to the order Leguminosae, and both these species have been imported on the initiative of the Department of Agriculture with objects entirely different from the variety of uses these plants have since their introduction been found to serve. Gliricidia has been established all over the coconut belt as a live fence, which yields a very large amount of fodder for all kinds of animals and green manure for the palms to such an extent that it can supplant the ordinary doses of fertilizers containing nitrogen such as are applied to palms in Ceylon. As for Leucaena the prospects are immense. Samples submitted by me for analysis to Mr. Joachim elicited the fact that dried Leucaena hay contained 30 per cent. more nitrogen than Lucerne hay. Lucerne or Alfalfa, which is the name by which it is known in Latin America, is the most valuable fodder known in the world. In recent investigations published in the bulletins of the Empire Marketing Board, it is stated that a farmer growing Lucerne even in England where the weather conditions are adverse to its perennial growth, the profit is more than ten times the profit that can be obtained by the growing of other types of fodder. In Ceylon where we can grow Leucaena as a perennial, yielding a fodder 30 per cent. better than Lucerne, the profits can only be looked upon as prodigious. Even in growing Leucaena I hope the Peradeniya authorities will supply us with data as to the quantity of leaf that an acre may yield under varying conditions of exploitation. It would be interesting to know how an acre planted entirely with Leucaena as the only crop compares with other acres interplanted with grain, oil seeds, or other crops as to yield.

I have already referred to the fact that Gliricidia and Leucaena were introduced to the Island from elsewhere to serve definite needs. The former was introduced from the West Indies during the 'nineties of the last century as a shade tree for cocoa, the original name when introduced was Madre de Cacao.

The introduction of Leucaena was due to the initiative of Mr. Stockdale who had experience of the plant in Mauritius, where it is looked upon as the best fodder for sheep and goats. These plants, in my opinion, have conferred a veritable boon to this colony—a boon which when reduced to an arithmetical estimate of its value may be found to yield a profit in less than ten years, the whole cost of the Department of Agriculture from the time of its inauguration more than sixty years ago to the present day.

The development of animal husbandry in the dry zone provides us with the master key for the development of the Wanni. We are from year to year shouting that Ceylon is an agricultural country, but we shut our eyes to the fact that there is no country in the tropics or elsewhere which is more dependent on agriculture than Ceylon. And yet all the teeming millions of Ceylon depend for their employment, and their living, on the area under agricultural products. All the other industries, professions, and avocations are subsidiary to, and parasitic on, agriculture. To put it in another form, the five millions of people living in Ceylon are dependent on the produce of not much over 3,500,000 acres of cultivated lands. An individual living in this Island has to be maintained on the produce of seven-tenths of an acre. When compared with other countries, I do not know any country where the capacity of a given area of cultivated land can maintain such a large number of inhabitants as Ceylon. This inference one may state from another standpoint; that is taking into account the standard of living, the profit yielded by an acre is very high in this country. This has been a factor of paramount importance in dealing with agriculture in Ceylon which few seem to realize. When reformers of agriculture, nationalists whose one obsession is that we must grow all the foodstuffs we consume, when those whose knowledge of economic science being nil, venture to assert even in the present day the time worn shibboleths and the discarded axioms of the mercantile system, that we must not allow money to leave the country in the purchase of useful foodstuffs and commodities essential to our well being, and on the other hand we expect the foreigner to buy the exportable commodities that we produce; all these do not realise that the commodities we export give us much higher profits per acre than most of the foodstuffs we import can possibly yield in Ceylon. It seems worse than ridiculous to ask a small farmer in Ceylon to grow cotton when the result of its cultivation will hardly give him the equivalent of his wages in return in an area where he can grow coconuts or tea which will yield him a nett profit of 40 to 100 Rupees per acre after paying himself the standard wage. The Indian ryot who has no other source of employment will work on his plot of land on which he has to pay a land tax, for a return of two to four annas a day. On this

miserable pittance he grows cotton, oil seeds, cereals, and pulses, currystuffs and such like and he is satisfied. The Ceylon small-holder will not be satisfied with such a meagre return for his labour; therefore he has to find crops that will give a greater profit, and buy goods which are produced abroad at much lower cost than he can produce.

I have stated already that this country contains not much more than 3,500,000 acres under cultivation which represents roughly one-fifth only of the area of this Island. The greater portion of the country is still a howling jungle or barren waste or scrub land. Leaving out another fifth of the Island as essential for a forest reserve and another tenth as stony or rocky land unfit for cultivation, the balance say half of the Island has still to be developed and cultivated. This is the problem which stares us in the face at every turn and which statesman, state councillor, nationalist, or political agitator has to face, and attempt to solve. The only way to solve the problem of cultivating the vast tracts known as the Wanni is to offer such an inducement to the pioneers who will open up these tracts as will assure them a fair profit in a reasonably quick time. I maintain from the data I have already given, and the reasonable conclusions derivable from them, that the master key to open these lands is centred in animal husbandry, which can be supplemented by foodstuffs and other money crops which the grower can easily sell. Let me try to place before you a practical scheme in a concrete form. Any such scheme, if it is meant to achieve success, I submit, must satisfy the following conditions, viz:

(a) The enterpriser, who in this instance is out for adventure, must obtain a satisfactory profit proportionate to his courage in undertaking the experiment, and moreover the profit so obtained should emerge in a reasonably short period of time.

(b) The occupation offered to him should be fairly healthy sufficiently healthy to tie him to the land, and make him a resident of the area selected by him for himself and for his successors in the ownership of the land.

(c) The transport facilities which he can command should be so reasonable, that he will not be handicapped by the artifical restrictions placed on his exportable surplus, by monopolistic arrangements such as shipping rings and similar agreements that force him to accept lower prices for his produce, when compared with other countries that are free from such a handicap.

I submit that the days for large profits per acre are over. The area available for tea and coconuts, or even for rubber about whose ultimate destiny I am by no means a pessimist, is limited when compared with the Wanni where the land is there for the asking. In these circumstances these areas should be opened up by large or small capitalists. Taking a small sized farm, a planter of limited means may lease a plot of land from twenty to fifty acres. He can put this under cultivation with fodder crops as I have described and take up animal husbandry, first with small animals that breed quickly, such as sheep, goats or pigs. He can cultivate another plot of foodstuffs, and money crops which can be sold easily in the district. Even in the dry zone a net profit of over rupees forty per acre may be obtained by growing fodder. This with other items of supplementary products will be a sufficient remuneration for a small-holder. On the other hand those who can command a larger capital can develop their lands with higher profits owing to the fact that they can use machinery for many processes in their farming operations. You may ask where then the goiya comes in. He must walk in the track of the capitalists as camp followers following a fighting regiment of soldiers.

This is not a new feature in the agricultural development of Ceylon. Villagers have been successful coconut and rubber planters owning small holdings, by at first working for wages on estates, learning their business in opening up land and in cultivating them. They can save money from the wages obtained because wages in pioneering districts are generally high, and after a few years of apprenticeship they can start on their own. In this country the acreage of coconuts and rubber, in the possession of small-holders, is over a third of the whole area under cultivation in these products. It is only in this way that the thrifty hard-working villager can be helped to become an independent landowner. The attempt to segregate villagers in a farm colony, with no capital and a meagre area of land to cultivate, is bound to end in failure. No provision is made in these schemes for the villager to find food between the period of opening the land, and the time when the first crop could be harvested. Even if this period be tided over by borrowing, it is not possible for a man and his family to live on the produce of an acre or two of land, which is the amount now allocated on these experimental schemes.

The dry zone as most of you know is malarious and intensely so in centres where paddy is cultivated under irrigation. Hitherto every attempt to open up the Wanni has been made *qua* irrigated paddy. This is absolutely wrong and it is the result of the ignorance of those who inaugurate such schemes, in

the elementary principles of malaria control. Malaria is heightened and increased wherever stagnant water is created, with every season of paddy cultivation. It is only drainage that can reduce the production of malaria in the dry zone. The only practical method from a health point of view, whereby these lands could be safely cultivated is to open up the high lands first, plant them with ordinary farm crops which require drainage, with animal husbandry as a profitable bye-product. It is in this way that the unirrigated lands of the Chilaw, Negombo and parts of Kurunegala Districts have been opened up in coconuts, and areas once intensely malarious have been converted into fairly healthy areas, with a population contented and profitably employed.

Lastly it is essential that transport facilities be available for the produce of these lands. In this matter I do not mean internal transport only, such as roads and railways, which are already available over a great portion of the dry area, but it is essential that as the produce that can be grown are bulky, such as maize, millets, cotton, hay, sisal, etc. that the shipping freight charges of the exportable surplus should be no higher than the charges that growers in other countries have to pay for their exportable bulky goods.

Ceylon is most severely handicapped by the stranglehood which the local Shipping Conference has brought about on the Ceylon producer of bulky goods. At the present time Conference control has almost disappeared from Java, Sumatra and Dutch East Indies with the result that Java exports sugar to India and Ceylon at the remarkably low rate of six to eight rupees a ton weight. Bombay, Calcutta and Madras can export jute, cotton, and oil seeds to the United Kingdom or to the Continent of Europe from 10 to 15 shillings a ton. Whereas Ceylon copra is charged something like 56 shillings a ton weight to the same destinations. The problem of abolishing the Shipping Conference is, therefore, very vital to the agricultural expansion and development of this country. Ceylon can grow and does export valuable fibres, such as coir and kapok. These fibres have to pay now as freight a great deal more than their value in the local market. In the case of sisal fibre the Director of Agriculture had to pay as freight more per ton than what it cost him to grow and harvest. This freight had to be paid as there was no local market for the fibre. At a time when the freight rates have come down by more than forty per cent. of the rate which ruled two years ago all the world over—Ceylon is precluded from such low freight charges owing to the selfish and immoral policy

of the Ceylon Shipping Conference; nay very recently instead of lowering freight charges the local Conference actually raised their rates at a time when millions of tons of shipping were idling abroad without goods to carry and when at our very doors in the port of Colombo thousands of tons of shipping enter and clear out of the port in ballast every month.

As mentioned earlier in this paper I have attempted to give you a summary of my experiments conducted for a number of years in the improvement of pasturage on coconut estates. I have placed before you data gathered from these experiments. The results disclose, if my conclusions are correct, that Ceylon possesses unlimited sources of wealth in its dry areas, which when properly exploited can lead this country to its right place in the tropical world as the first and most successful unit in the Colonial Empire. I do not deny that I am an optimist as regards Ceylon's future but this optimism is born out of an intimate and personal study of the methods that I have practised for a number of years. The discovery which was gradually forced on me that animal husbandry and general farming offers the most successful solution for the opening of the Wanni, I now place before you in the hope that it may enable others to test these methods themselves, and thus help materially the agricultural advancement of our country.

To those of us who have passed the meridian of life it will not be given the privilege of entering the fair land of promise, when the whole of the dry zone will be overflowing with milk and foodstuffs, but even so we may gaze on that fair prospect from the Pisgah heights of our imagination.

THE COCONUT INDUSTRY IN THE ANDAMAN ISLANDS

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TAKING into consideration the fact that all the shores of the Bay of Bengal are homes of the coconut palm it is a remarkable coincidence in the Andaman flora, that, excepting the Cocos Islands in the north of the group, no coconut palms, naturally propagated, are to be found in the Andamans. Yet next to timber, one of the principal and most profitable industries of the Islands is the cultivation of the coconut palm.

Since 1880 spasmodic efforts were made to introduce this valuable tree; and a considerable number of them, now in full bearing, can be seen planted along the roads, along the sea shore and in scattered patches all over the Settlement. The trees were at first planted in swampy areas. Measures were then deemed necessary for the preparation of a systematic working plan, which would ensure that future extensions were on suitable soil, in compact blocks, and commanded so far as possible, by water transport, which is more economical than conveyance by carts.

Private Enterprise.—In the year 1914 the then Chief Commissioner, Colonel M. Douglas, realising the potential wealth, the suitability of climate, and other favourable conditions, decided to open out systematically extensive areas in the vicinity of Port Blair. From 1914 to 1918, nine separately situated areas, aggregating about 2,000 acres, were planted. Owing to the scarcity of level land, the bulk of which is taken up for paddy cultivation, the coconuts were planted out on low-lying hills with an average altitude of 250 feet above mean sea level, thereby providing a natural drainage to the sea. The soil on these areas is a rich clayey loam, fertile, but somewhat deficient in available phosphoric acid. The plantations were, however, not established on scientific lines. Too close planting, indifferent seed selection and absence of cultivation during the early stage of the palms, somewhat retarded their growth with the result that they will not reach maturity until 1930-31. The bulk of the plantations were leased to private enterprise during 1922.

Marketing Methods.—It is a well-established fact that the cultivation of coconuts and bringing their produce to market is a matter of great simplicity. Probably no other industry of a like nature calls for so little skilled labour. Once the palm has reached the bearing stage the harvest is continuous. The disadvantages, on the other hand, are a considerable capital outlay, and a long waiting period before the trees reach the bearing stage. The cost of establishing and bringing into bearing a coconut plantation in the Andamans is approximately Rs. 375/- per acre. This amount does not include interest on capital.

With 60 trees to the acre and a crop of 50 nuts per tree per annum, the yield per acre per annum would be 3,000 nuts. Estate expenditure (owner managed) including salaries of subordinate staff, cultivation, crop expenses, upkeep for buildings and boats, general charges, Government Land Revenue, and landing the produce at Rangoon, Burma, come to about Rs. 4/8 per 100 nuts, thus leaving a substantial margin of profit to the grower, as the average selling price at that port at the present time amounts to Rs. 6/8 per 100 nuts.

During normal times the price of coconuts in the Rangoon market realized Rs. 12/- per 100 nuts, but owing to the general trade depression and the recent rebellion in Burma the price has come down by 50 per cent.

Middle East Competitors.—Statistics show that Burma imports coconuts to the extent of nearly ten lakhs of rupees annually. In selling his produce the planter in the Andamans has a decided advantage over his distant competitors in the Middle East, for the reason that Burma, which is a very great consumer of nuts, is but 36 hours' journey by steamer from Port Blair. This admits of the nuts being shipped whole, though free of the husk, and thus they are considerably more profitable to the grower than if sold as copra.

Over-sea transport.—Regular communication is established between Port Blair and the ports of Rangoon, Calcutta and Madras by two steamers of the Asiatic Steam Navigation Co., Ltd. chartered by the Government of India.

Coconut Diseases.—Another remarkable feature of the Andamans is the total absence of the notorious "Black Beetle" (*Oryctes rhinoceros*) and the "Red Weevil" (*Rhynchophorus ferrugineus*), as well as any of the fungoid diseases such as Bud Rot, etc. which are so prevalent in most of the other coconut-growing countries.

On some of the plantations in the Settlement the palms are attacked by what is known as "Bleeding disease" (*Thielaviopsis ethaceticus*). But this is not a serious disease and need not cause any apprehensions.

Rats at times also commit depredations. During the last two years a slug caterpillar, identified by the Imperial Entomologist, Pusa, as *Thosea unifascia* Walk, defoliated in restricted areas a large number of palms; but this pest appears to have been checked through natural enemies, and a wilt disease. Except on a small isolated area the caterpillar has not again been recorded. The question of diseases need not cause any alarm. The Government has been advised to introduce legislation with a view to introducing a "Plant Pest Enactment" as prevailing in Ceylon, Burma and the Federated Malay States; planters will have the assurance that should any of the serious pests, accidentally be introduced, suitable measures will be taken to prevent the disease taking root in the Islands.

Another great advantage is the fact, that troublesome weeds such as Lantana and Alang Alang (*Imperata arundinacea*) do not exist here.

Grants to Growers.—With a view to encourage the expansion of the coconut planting industry the Local Administration is prepared to lease out on favourable terms, blocks of land to interested parties, backed with the necessary capital. The terms of the grant for the growing of coconuts are: Annas 4 per acre for the first 12 years; Rs. 3/- for the next 18 years. On renewal of the lease the revenue assessment shall not be liable to enhancement by more than 100 per cent. of the last assessment. In addition to the land revenue an educational cess is levied amounting to Rs. 0-0-8 per rupee of the land revenue assessable. Considerable areas of suitable land are available within the Port Blair Settlement. Several of the adjacent Islands such as Neill, Tarmugli and the Little Andamans which are within easy reach of Port Blair, would also probably be made available to interested parties.

General Remarks.—Such lands as are available for coconut growing are about 200 feet above mean sea level, and consist of low undulating hills, providing excellent drainage to the sea and are well sheltered. Rainfall is about 120 inches per annum evenly distributed. The S. W. monsoon from middle of May to beginning of November and the N.W. monsoon from November to end of January, February, March and April are the driest months, but even during this dry period, showers of rain occur frequently. The climate may be described as normal for tropical islands of similar latitude. It is warm always, but tempered by sea and land breezes.

Malaria and the usual intestinal diseases prevail, but with proper precaution need not cause any anxiety. Government maintains large and fully equipped hospitals and dispensaries, supervised by a staff of Senior and Junior Medical Officers. Generally speaking the health of the Settlement is very satisfactory as most of the malarial swamps have been filled in. Good drinking water is available during the whole year.

All local transport is principally arranged for by sea. It is therefore easy and cheap. Government maintains all launches, lighters and boats, which are hired out whenever required at a moderate charge.

A limited quantity of free labour (ex-convicts) is available locally. The bulk of the labour force required by local planters consists of Tamils and Telugu, who come over here periodically accompanied by their families, from Madras. They comprise skilled climbers and huskers, and are paid 10 annas per man per diem, and are provided with free accommodation and medical attendance.

Taken all round coconut plantations in this Island are a valuable asset, especially as there is such a lucrative market on a nut selling basis, available in Rangoon, to which port all the local produce is now exported monthly. The demand in that place is in excess of supply so that there need not be any necessity for a long time yet to come of making copra.

TRIAL OF A HAND-THRESHING MACHINE FOR PADDY

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IN some parts of Ceylon owing to lack of suitable grazing ground animal labour is scarce. Threshing is done by men trampling the sheaves under foot. This is a very tedious and expensive operation. A small portable hand threshing machine thought suitable for the average smallholder-cultivator of paddy was imported from Messrs Jardine Matheson & Co., Kobe, Japan, at a cost of Rs. 58·75 landed at Colombo.

The machine is light in weight, easily transported and simple to handle. The enclosed revolving drum of the machine is studded with 'U' shaped nails, and a wooden cover over the drum prevents the grain from scattering. The machine is fed by the same person who works the treading board. Another worker places on an improvised table handfuls of sheaves within reach of the operator and relieves him every hour. A woman gathers the threshed grain, clears the straw and later sorts out the unthreshed and broken ear-heads for re-threshing under foot. The latter operation is necessary although the cost is prohibitive. It is reported that in Japan the output of this machine is about one *koku* of paddy per hour, a *koku* being approximately 4·975 bushels. Whether this is clean paddy is not known. The paddies of Japan being extremely high yielders the output per hour will be much higher than in Ceylon, and it is possible that, like the selections from Burma under trial in Ceylon, that they shed their grain easily. Of the Ceylon varieties the *samba* and *balawi* types shed their grain comparatively more freely than the *hatiel* and *honderawala* types, but to a much less degree than the Burma types.

Preliminary trials with the first machine imported into Ceylon in July 1929 were conducted by the Divisional Agricultural Officer, Central Division [1] and appeared to point to its suitability. It was, however, necessary to conduct further trials under average conditions with records of cost and output based on clean paddy.

Table I A

Cost of Threshing by Japanese Machine followed by Hand Winnowing

Variety of paddy		Selection I-CPY-15
Weight of sheaves threshed	...	1500 lb.
Cost of threshing	...	Rs. 2·68
Cost of winnowing	...	,, 0·28
Total output of clean paddy	...	Bus. 6 meas. 14
Cost per bushel threshing and winnowing		Rs. 0·45
Cost per 100 lb. threshing and winnowing		,, 0·95

Produce of a 4 months' crop. Straw rather short and thin, ear-heads small.

Table II A

Cost of Threshing by Japanese Machine followed by winnowing through 'Chindwin' winnower

Variety of paddy		Selection I-17
Weight of sheaves threshed	...	2000 lb.
Cost of threshing	...	Rs. 2·99
Cost of winnowing	...	,, 0·20
Total output of clean paddy	...	Bus. 12 meas. 20½
Cost per bushel threshing & winnowing	...	Rs. 0·25
Cost per 100 lb. threshing & winnowing	...	,, 0·52

Produce of a 6 months' crop of good growth. Straw stout and long, ear-heads large, sheaves when threshed slightly damp and pliable.

Table III A

Cost of Threshing by Japanese Machine followed by winnowing through 'Chindwin' winnower

Variety of paddy		Selection I-17
Weight of sheaves threshed	...	1600 lb.
Cost of threshing	...	Rs. 3·22
Cost of winnowing	...	,, 0·17
Total output of clean paddy	...	Bus. 9 meas. 2½
Cost per bushel threshing & winnowing	...	Rs. 0·37
Cost per 100 lb. threshing & winnowing	...	,, 0·78

Produce of a 6 months' crop of average growth. Straw fairly stout and of medium length, ear-heads of average size. Sheaves well-dried before threshing hence straw rather brittle.

Table I B

Cost of Threshing by Buffaloes followed by Hand Winnowing

Variety of paddy		Selection 1-CPY-15
Weight of sheaves threshed	...	1500 lb.
Cost of threshing	...	Rs. 1·15
Cost of winnowing	...	,, 0·26
Total output of clean paddy	...	Bus. 7 meas. 6
Cost per bushel threshing & winnowing	...	Rs. 0·20
Cost per 100 lb. threshing & winnowing	...	,, 0·41

Produce of a 4 months' crop. Straw rather short and thin, ear-heads small.

Table II B

Cost of Threshing by Buffaloes followed by winnowing through 'Chindwin' winnower

Variety of paddy		Selection I-17
Weight of sheaves threshed	...	2000 lb.
Cost of threshing	...	Rs. 1·71
Cost of winnowing	...	,, 0·13
Total output of clean paddy	...	Bus. 12 meas. 14
Cost per bushel threshing & winnowing	...	Rs. 0·15
Cost per 100 lb. threshing & winnowing	...	,, 0·31

Produce of a 6 months' crop of good growth. Straw stout and long, ear-heads large, sheaves when threshed slightly damp and pliable.

Table III B

Cost of Threshing by Buffaloes followed by winnowing through 'Chindwin' winnower

Variety of paddy		Selection I-17
Weight of sheaves threshed	...	1600 lb.
Cost of threshing	...	Rs. 1·53
Cost of winnowing	...	,, 0·11
Total output of clean paddy	...	Bus. 10 meas. 19
Cost per bushel threshing & Winnowing	...	Rs. 1·15
Cost per 100 lb. threshing & winnowing	...	,, 0·32

Produce of a 6 months' crop of average growth. Straw fairly stout and of medium length, ear-heads of average size. Sheaves well dried before threshing hence straw rather brittle.

Cost of labour calculated as follows :

Men	...	...	-/75 cts. per day
Women	...	...	-/45 ,, ,, ,,
Boys	...	...	-/40 ,, ,, ,,
Buffaloes	...	...	Rs. 1/- per pair per day
Working day	...	...	8½ hours

Average weight of a bushel = 48 lb.

Summary of cost per 100 lb. of threshing and winnowing by the various methods

Test IA—Threshed by Japanese Machine and Hand winnowed	Rs. 0·95
Test IB—Threshed by buffaloes and Hand winnowed	,, 0·41
Test IIA—Threshed by Japanese Machine & winnowed through 'Chindwin' winnower	,, 0·52
Test IIB—Threshed by buffaloes and winnowed through 'Chindwin' winnower	,, 0·31
Test IIIA—Threshed by Japanese Machine and winnowed through 'Chindwin' winnower	,, 0·78
Test IIIB—Threshed by buffaloes and winnowed through 'Chindwin' winnower	,, 0·32

In the trials under review Tests IA and IB were conducted at the conclusion of the *yala* 1929 harvest with I-CPY-15, a pedigree selection of *suduheenati*. Due to the shorter growing period during the *yala* season, the crop is both poorer in growth and lower in yield when compared with the *maha* season crop on the same field. The cost per bushel of threshing such paddies is higher. The remaining tests were conducted at the end of the last *maha* 1929-30 harvest with I-17, a pedigree selection of *hatiel*. In order to ascertain the optimum condition for threshing by machine two lots of sheaves—one damp and from a well grown crop (Tests IIA and IIB) and the other well dried and from an average crop (Tests IIIA and IIIB) were threshed separately. The quantity of sheaves used in each test was about the same a *goiya* (cultivator) would normally employ a pair of buffaloes to thresh. It will be noticed that a heap weighing 1,600 lb. of well dried sheaves (Tests IIIA and IIIB) approximated to a heap weighing 2,000 lb. of rather damp straw used in Tests IIA and IIB.

When very dry sheaves are passed through the machine a considerable quantity of broken bits of straw and unthreshed portions of ear-heads are found in the unwinnowed paddy, necessitating sorting and re-threshing under foot. Stiff and thick culms too retard the rate of threshing. The optimum condition for threshing by machine was found to be when the culms were pliable and not permitted to dry too much and consequently become rather brittle.

It will be seen that the average cost of threshing by the Japanese machine is about double that when buffaloes are employed and the appreciably extra time taken by the former process is a serious drawback. With larger quantities the disadvantages will be more pronounced.

In areas where animal labour is scarce and threshing has of necessity to be done under foot, and also in areas subject to floods soon after harvest, this type of machine or preferably an improved one with a longer revolving drum permitting two workers to feed the machine at the same time and constructed of more durable material, would serve a useful purpose. With varieties of paddy which shed their grain easily the economy of such machines would be enhanced. When dealing with small experimental plots which had to be threshed separately the machine was found very handy.

Threshing, however, is normally done only in fine weather and on the *kamatha*, a well prepared site with a clay plastered surface: under these conditions the alleged greater loss of grain when threshed by other means than by machine will not occur.

Further, it may be mentioned that within limits whether a small quantity or the normal quantity of sheaves is threshed by buffaloes the same time would be taken. If larger heaps of sheaves are threshed by employing an additional pair of buffaloes the work would be completed in practically the same time and the cost of threshing would be reduced considerably. It is obvious that it would be uneconomical to use this type of threshing machine where animal labour is available and for varieties of paddy which do not shed their grain easily. The villagers depend on the straw for renovating the roofs of their dwelling houses and for feeding their cattle, in particular, and occasionally their buffaloes. A serious objection to the use of this type of threshing machine is that the straw is not crushed as when threshed under foot; hence, it is neither suitable for thatching roofs nor is it relished either by cattle or buffaloes.

The writer has seen an effective method adopted by Prof. R. C. Wood of the Imperial College of Tropical Agriculture, Trinidad, B.W.I. The process is as follows: Handfuls of sheaves are beaten a few times against a horizontal trellis thereby causing over 75 per cent. of the grain to drop off. The incompletely threshed sheaves are stacked in the usual manner for protection against rain and later, whenever convenient, the sheaves are re-threshed by employing animal labour and the remaining grain is recovered. Lord [2] reports a rather similar method adopted by the Tamils in Malaya.

It is proposed to conduct a series of tests next season and work out the economics of the various systems of threshing.

My thanks are due to Mr. K. D. S. S. Nanayakkara for assistance in supervising the trials.

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CITRUS ROOT-STOCKS*

THE question is frequently asked. "Why not grow fruit trees from Seeds?" The answer is that where improvements have been made these qualities are usually not transmitted through seed, but are perpetuated through the buds. Hence the necessity for using parts of the vegetative portion of the plant for the purposes of propagation. The Mendelian discovery has only comparatively recently explained this phenomenon, but practical attainment preceded the theoretical explanation by centuries, and the arts of budding and grafting have preserved the desired fruit varieties throughout succeeding generations.

The extreme antiquity of the practices of budding and grafting are illustrated by the writings of Columella, a celebrated Roman authority on all matters connected with agriculture and horticulture in or about the year A.D. 55. He wrote: "The ancients have taught us three kinds of engraftments, one which after the tree is cut and cloven receives the scions which are inserted into it, another which admits the graft between the bark and the wood, both which kinds are proper for the spring season. The third, which the husbandman calls "emplastration", receives the buds themselves, with a little bark into a part of itself, from which the bark is pulled off."

This "emplastration" to which Columella refers is clearly budding, as we understand it today.

The use of such asexual methods of propagation introduced into horticulture the scientific problem of the relation and interaction of stock and scion. Much attention has been given by horticulturists to these reciprocal influences, and after many years of research, the problem is more clearly, though by no means, perfectly understood.

Citrus growers throughout the world have observed great variations in the yield of different trees in the same orchard, under the same conditions, and this variation is now understood to be due to one of the following factors:

1 Variations inherent in the buds from different parent trees.

2 Different kinds and character of stocks used.

3 The character of the union obtained at budding.

4 Differences in individual environment, especially as to soil and climatic conditions under which the trees are growing.

5 Accidental and unavoidable differences in treatment given to different trees.

Of these factors, the influence of the character of the stock is probably of the greatest importance, and the purpose of this article is briefly to consider the question.

The experience of citrus growers in various countries of the world has clearly demonstrated that no one stock is satisfactory for use in all locations and under all conditions. In California, the bulk of citrus trees are budded on the Seville or sour orange, *Citrus Aurantium*, whilst a few are worked on the sweet orange *C. Sinensis*, pomelo *C. Paradisi* and the trifoliate orange, *C. Trifoliata*. In Florida, the Seville orange is probably most extensively

* Extracted from Agricultural Supplement No. 51 to the Cyprus Gazette No. 2242.

used, but the rough lemon, *C. Limonia*, and sweet orange stocks are also used to a considerable extent, as is also *Trifoliata*; the latter stock chiefly for the mandarin type of orange. The sweet oranges stock is rather indiscriminately used on all types of soils, but is more or less avoided in most countries because of its susceptibility to root diseases. In South Africa, extensive experience definitely shows that the rough lemon stock is the only one that can at present be recommended for general use, being the only stock fully tested that has given uniformly good results. In Palestine and Cyprus the chief stocks for citrus are the "Sour" or "Bitter" orange, *C. Aurantium*, and the sweet lime (or sweet lemon, as it is often erroneously called) *C. Aurantifolia*.

Dr. Webber, one of the world's authorities on this subject states: "If a critical examination of the evidence relative to citrus stock is made, it will be admitted that in no country is the evidence sufficiently exact and extensive to justify an assertion that a certain stock is the best and only one to use. All that we can say is that certain stocks have proved to be successful and are the best available".

The Sour, Bitter, or Seville Orange (*C. Aurantium*)—This stock has proved generally satisfactory in California and is now commonly employed in Palestine and Cyprus, where experience has proved it to be superior to any other, in the long run. It is characterized by a well developed root system which spreads and penetrates deeply into the soil; it is resistant to the various root diseases and next to *C. Trifoliata* is the hardiest of citrus stocks in common use. According to the experience of growers in several countries, the quality of fruit produced on this stock is of high grade from the time the tree begins to bear.

As an instance of the effect of environment on stocks the following case is worthy of note. Some years ago *C. Aurantium* was recommended for trial in South Africa, on the basis of its almost universal success in other countries. It was extensively used but was found to be a complete failure. Its failure, as a stock in South Africa, is difficult to understand and the case is rendered more perplexing by the fact that the Seville orange grown there as a seedling, does well and appears to be vigorous, healthy and of normal size. A number of problems at present besetting the citrus industry of South Africa would be largely obviated if *C. Aurantium* could be successfully used there as a stock. Fortunately, it grows naturally and well in Cyprus under the common name of "Bitter" orange and it is unquestionably the stock to be recommended, at present, for future citrus plantings in Cyprus. It is now being widely used in Palestine, and a concrete instance of its superiority over the sweet lime stock in that country, where conditions are to all intents and purposes similar to Cyprus, is given below:

"There were two plantings alongside each other, one consisting of Jaffa oranges on sweet lime stock and the other of Jaffa oranges on sour or bitter orange stock. The trees on sweet lime stock were 17 years old and the ones on sour stock 15 years. The planting distance was about 20 feet in both cases, the square system being employed. The trees on sweet lime were showing considerable "die-back", many of them were infected with gummosis, they were not uniform, they were carrying only a fair crop, and the fruit was of inferior flavour, whilst the trees on the sour or bitter orange stock, although two years younger, were very much bigger, viz. had a larger potential bearing surface, free from disease, very uniform and well formed, and were carrying a heavy crop of the highest quality fruit".

The Sweet Lime (C. Aurantifolia).—This stock is very early maturing, but its extreme susceptibility to the various root diseases, especially gummosis, renders it unfit for use except on the very lightest soils. Trees worked on this stock invariably start to deteriorate at an early age, whilst a normal citrus tree should increase in production, according to recent investigation, at any rate up to 40 years old. The use of this stock should be avoided wherever possible.

Importance of Root-Stock Selection.—It is a common observation that some orchards grow and develop satisfactorily from the time of planting, while others on similar land, receiving similar treatment are always lagging behind. Such differences, when a standard variety has been used have commonly been ascribed to differences in local environment and different care, but it has become evident that all the variation exhibited cannot be thus explained.

The differences in the stocks used are undoubtedly one of the chief causes of this variation, as the stocks are seedlings from many different parents of unknown character and thus no single one is ever just like any other one.

In Cyprus, practically all our citrus trees are budded either on sweet lime stocks or bitter orange stocks, not of any particular strain, but just any sort of stock as long as it is a sweet lime or a bitter orange.

To illustrate the far-reaching effects of this lack of selection, the following experiment is quoted. In preparation for an extensive fertilizer experiment in California, a nursery of some 16,000 trees was grown of Washington Navels, Valencias and Marsh grapefruit. Good seeded stock was selected from the nursery and buds were used from the best selected trees of known standard type. Planting and all other cultural operations was performed with the utmost care to secure uniformity of treatment, and an excellent and apparently very uniform nursery was produced.

Later, upon inspection, it was found that there was a big variation in the size of the trees, some having trunks $\frac{3}{4}$ inches in diameter and others $1\frac{1}{4}$ inches in diameter. Dr. Webber, who was in charge of the experiment, now decided to lay out a small experimenal orchard with the trees thus varying in size. Rows were planted with large, medium and small trees and the treatment given was as uniform as possible. After a lapse of seven years, there was still the same marked difference in size between the rows, and the consequent difference in the productive capacity of the trees was also noticed. In ordinary practice, *all* these trees would ultimately have been planted in commercial groves.

The variation in size of nursery trees may be influenced by factors such as variation in environment, nature of stock and natue of bud used, but investigations have clearly revealed that the most variable element and probably the one responsible for the greatest part of the variation is the variability in the stocks used.

It is clearly evident that if we desire to produce uniform orchards, where every tree is to be a producer of revenue, it will be necessary to pay more attention to the selection of stock strains. Not merely any sweet lime or bitter orange, or whatever seedling we are going to use is going to be suitable, but a certain strain of a particular type, which by trial is known to produce batches of seedlings of uniform size and character.

In making a stock selection the following points should be considered:

1 *Seed.*—The seeds should be obtained from parent trees of known character. They should be sorted, and all weak and unhealthy seeds should be removed. Further, it is no use of selecting all the largest seeds, as citrus seeds are polyembryonic and it may thus occur that one big seed will give rise to two or more weakly seedlings, whereas a medium-sized healthy seed with only one embryo will usually give rise to one vigorous seedling.

2 *Transplanting from the Seedbed.*—At this stage only those seedlings with perfect root systems, and those which are most vigorous, viz. the largest, should be used. All seedlings with "bench" roots, and those with twisted tap roots should be discarded. Fully 60 per cent. of the seedlings from the original seedbed usually have to be discarded at this stage.

3 *Budding.*—Only seedlings which are true to type and show no signs of variation should be budded. A further weeding out of the weaker stocks should be made at this stage. It is a grave mistake to leave undersized stocks for an extra few months, in order that they may attain budding size. Their growth rate is slower than that of the large vigorous seedlings, and this difference in size will always be maintained.

4 *Transplanting into the Grove.*—When the young trees are transplanted into their permanent positions, only those true to type should be used. All "wild" ones, and those stunted in growth should be discarded.

It will be observed that the above system of stock selection gives four checks on variation, and if stock selection is thus followed carefully at each stage in the growth of the young tree, the grower can be assured of a fairly uniform batch of trees. Trees (budded) and stocks of different ages should never be planted in the same block in the nursery. Nursery trees should invariably be grown in blocks; stocks just transplanted from the seedbed; one year old stocks; stocks ready for budding; and budded trees. At the end of the planting season, all budded trees not sold should be cleared off the land, and after a deep and thorough cultivation and perhaps a dressing of manure, the block should be replanted to young stocks straight from the seedbed.

AGRICULTURE AS AN INDUSTRY*

THOUGH agriculture is the most primitive of the industries, for it began when the wandering hunters or pastoralists fixed their abode for the season's cultivation, it is never regarded as one with the other industries, but as an occupation apart. The categories of agriculture, commerce, and the industries are adopted by the economist as by the man in the street.

This is because it has never shared, except to a very limited extent, the concentration which has become characteristic of the industries proper, ever since the power factory began to swallow up the home crafts and domestic workshops. Broadly speaking, the food production of the world is done on peasant farms, worked by one man and his family, with perhaps a little extra labour at harvest. The size of the holding thus occupied may vary very greatly. In the wheat-belt of Australia the one-man farm may be 1,000 acres, in the Middle West the typical holding is a quarter block of 160 acres. In Europe, on fair cultivable land farms of 10 to 20 acres are very general. The extreme cases are met with in China, Japan, and India, where the holding may be no more than two acres, but is still the sole support of the family. In parts of China may be found densities of rural population up to 3,000 per square mile, of whom 90 per cent. may be engaged in the cultivation of the land. As a general correlation, one may say that the output per acre increases as the holding gets smaller, but the output per man increases with the size of the holding. The single-handed Australian wheat-grower will produce up to 3,000 bushels per season; good English production, apart from recent examples of power farming, will average about 1,200 bushels per man employed.

Almost as a necessary corollary, it follows that the greater the sub-division of the land in a self-supporting community the greater will be the proportion of its populaton engaged in cultivating the land. One can contrast the position in parts of China mentioned above with France, which before the war was almost self-supplying as regards food and had about one-half of her population on the land. In Great Britain only about one-tenth of the population are employed in agriculture, but less than half the food the country consumes is produced there. As farming is now being conducted in Western countries, about $2\frac{3}{4}$ acres of land is cultivated to produce the food and other agricultural products required by one unit of the population.

In Great Britain there has been from comparatively early times a drift away from peasant farming towards a capitalist system, with a master and labourers receiving a weekly wage. In the older farming of at least the East, Midlands, and South of England, the land was laid out in open arable fields sub-divided into acre strips. Each field carried the same crop on all the strips; there would be, for example, a field of wheat, another for barley or beans, and a third in fallow. Turnips and other fodder crops were unknown, the live-stock pastured on common grazings and the waste of the manor, and on the arable land after harvest. Each tenant of the manor had a certain number of strips, more or less scattered, in each field; these he cultivated himself and took the produce of. Enclosure—the division of these common fields into separate holdings and private ownership—

* By Sir Daniel Hall, K.C.B., F.R.S., in *The Empire Cotton Growing Review*, Vol, IX, No. 4, October, 1932.

began in Tudor times because the high prices of wool, then the staple export of England, tempted men to exchange cultivation for sheep-grazing. The process of enclosure went on apace in the seventeenth, eighteenth, and early nineteenth century, because of the growth of commerce and industry made demands for food which could only be satisfied by the improved cultivation of the land that was possible with enclosed fields. A few examples of unenclosed land will survive—*e.g.* Laxton, Northamptonshire and the Isle of Axholm; and on the heavy clay pastures of the Midlands one can still see the ridges and furrows of the old common fields.

The output from the land must at least have doubled as a result of the new farming that came in with the enclosures. At the same time the small peasant holdings began to be put together into larger farms. The unsuccessful peasants mortgaged their holdings in bad seasons and had to part with their land. They either sank into rural labourers or got away to the growing industries and commerce. In England from Tudor times there were always openings for men in other occupations than farming, and a continued drift from the land in consequence. We can see the results of this slow "rationalization" of our farming in the present distribution of the land; in 1924 exactly two-thirds of the cultivated area of England and Wales was held in farms of 100 acres and upwards. These larger farms employed on the average $2\frac{3}{4}$ men per 100 acres, so that if we take the typical English farm as one of 300 acres, the enterprise would be a case of one master and eight labourers. Such a distribution of the land into common fields divided into strips was probably general throughout the greater part of Northern Europe. The organization of farming into larger units has advanced more in Great Britain than in other countries, but the capitalist holding with wage-earning labourers is to be found in all the western European countries, though, except perhaps in southern Sweden, it is not the typical form of land holding. Really large-scale farms organized on an industrial basis are rare. There are great "domain" exploitations among the large landowners of East Prussia, but the similar estate farms of Poland, Czecho-Slovakia, Rumania, etc. have to a large extent been divided in response to agrarian unrest during the war. In Great Britain there are a few men in control of considerable areas, up to 12,000 acres, but as a rule the farms thus constituting a single business still appear as separate holdings in the Agricultural Returns, and are managed individually, only the buying and selling are centralized. It is only in some of the plantation industries—sugar, rubber, cotton, tea, and coffee, etc.—and again in certain forms of market gardening in this country and America, that anything comparable to factory organization can be found. In Russia the five years' plan for agriculture aims at replacing the old peasant cultivation in small units by extensive industrialized exploitations, but while it is clear that great advances in production have been realized, information is as yet unavailable as to the financial results or the stability of the experiment. It is noteworthy that the joint-stock enterprise is very rarely to be found engaged in general farming, and agriculture is thus cut off from the normal source of capital. In Great Britain farming is financed by private capitalists, assisted by bank overdrafts and credit from dealers, though, of course, under our renting system the landlord carries the bulk of the fixed capital.

Certain consequences follow from this predominance of the family farm in the business of food production. The individuals are weak commercial units. In so far as the products are not sold direct to consumers (*e.g.* the milk supplies to northern English towns, where the producer also has a round and sells from his cart), and have to enter the general stream of commerce for distant transport and export, there springs up a loose organization of dealers who collect the small parcels, grade and bulk them. The

producers are powerless against the dealers, who pay no more than will serve to keep the farmers in being. To some extent this dependence upon the dealers has been relieved by co-operation among the farmers, but co-operation is slow of growth, and has proved easy of organization only when the producers are working for an export market. Nor does co-operation remove the mechanical disadvantages of the small farm, its inadaptability to the use of power machinery and the economic organization of labour. Where the land is much divided it becomes difficult to carry out extensive schemes of land improvement such as drainage, of which the collective advantage may be great, though the individual advantage may be unequal and deferred. The strength of the peasant system lies in the willingness of the occupiers to work long hours, in the unpaid labour of the other members of the family and in the scope it gives for individual contrivance and economy. But even this latter virtue is discounted by the fact that peasant farmers regarded as managers of a business are unselected and constitute a random slice of the community, whereas the manager of an industrial enterprise is a man picked for his directive ability. The average performance of a group of peasant farms must therefore be low even as the average character or intelligence of any random group of men is low. Peasant farming is inevitably highly conservative, dominated by traditional practice, and but slowly receptive of new knowledge or scientific method. Indeed as compared with the great industries, peasant farming affords little scope for the application of scientific research. New fertilizers or improved varieties produced by the plant-breeder can readily be demonstrated to the farmers, and will be adopted by degrees according to the intensity of the propaganda. But changes in the system of farming are less capable of demonstration, and often the results of scientific investigation require a prolonged period of working out before the laboratory conclusions lead to a practical process. This intermediary stage is normal in factory enterprise, but is quite impracticable in a system of small units. To take an example, genetic science indicates the way to considerable improvements in the breeding of live-stock, but the experimentation and selection would require work on thousands of animals over a period of years. There is under the existing system of farming no possibility of financing the preliminary work nor of being repaid for success. The only method by which the peasant farms can be linked up to a large directed enterprise is to tie them to the processing factory, and make them work to a schedule.

One may sum up the situation by saying that peasant farming is a mode of living rather than a business for profit, and that the food, etc. on which the urban population depends are little more than the by-products of the peasants' activities.

Broad consideration of economy of man-power must exert pressure in the direction of building up large farms on which the cheapening of production would be effective and would make profits. But farming is still so much of a "mystery" that the capitalist has always been shy of venturing into it, and the cutting of prices to which the peasants are subject keeps wholesale prices down until the margin of profit to tempt the capitalist into the business is less than might be expected. In this country, again, skilled managers capable of handling a 10,000 acre unit would be hard to find, because, there has been no opportunity for obtaining experience of the kind. A man may be an excellent manager of even 1,000 acres which he can keep under his own eye, and yet lack the organizing ability to deal with ten times that area. Of this failure examples are not lacking. Nor under existing conditions would it be easy to obtain blocks of land suited to such a purpose. English land is still sub-divided into a number of ownerships, many of them held for non-economic reasons. On any estate

the woodlands, shaws, and spinneys are numerous, and though producing little in the way of timber, are valued for game, and would have to be purchased at an uneconomic price. An estate managed for production would want to remove both them and the hedgerows, but the capital expenditure would relatively be excessive, and would only slowly give returns. In other parts of Europe where the land is still more sub-divided and where peasant ownership is general, the obstacles to the creation of large farming units are far greater; any general movement in that direction would create a social upheavel. So far from adopting a policy of the kind, however, consistent with a planned national economy, continental nations are in general committed to the preservation of peasant farming by means of protective duties to maintain prices and obviate the competition of the newer countries with extensive cheap production. In France, at the moment of writing, the wheat growers are demanding Governmental aid, and organizing themselves to withhold wheat from the market because the price has fallen to 120 f. per quintal. This is equivalent to 14s. per cwt. the world price being 6s. to 7s. per cwt. in Europe, and the price that is being guaranteed to English farmers by legislation being 10s. per cwt. In Czecho-Slovakia the internal price of sugar from beet it being maintained at about three times the price at which the surplus (nearly one-half of the production) is being sold in the world market, largely to Great Britain. Of course, duties also enter into the internal price of sugar, but the fundamental fact is that the Government dare not abandon the peasants to the play of the open market, and sugar beet is an essential feature in their cultivation.

No citizen, rural or urban, but has to reflect upon these matters. An adequate food supply is the basis of civilization, and every state has to consider how to maintain it. Even in easier times than the present world depression the complaints of the farmers about inadequate returns are general in every country; it is necessary that their position should be one of reasonable prosperity, because their demand for commodities really sets the ball of trade rolling. We may dismiss the idea of overproduction, save as a temporary and local affair. The demand upon the farmer is almost infinitely elastic; not that the consumers can eat more, but because with every expansion of income the demand shifts to better types of food which call for more labour in their production. The present Orientals would like to exchange rice for wheat, just as the Baltic peasant would forego rye if he could afford wheat; a very large proportion of the working classes of all countries live mainly upon cereals, and wish to increase the meat and milk in their dietaries; the English housewives buy more vegetables and fruit as wages increase.

During the last sixty years the wages of the British working classes have been steadily rising, at the same time the prices of the prime food commodities were equally falling, and again are approaching the pre-war levels. But the response has not been so much a reduction in the gross expenditure of the family upon food as a demand for kinds of food that were previously beyond the income available to large classes of the community. The average consumption of meat and milk has increased, still more have vegetables and fruit, hitherto almost luxuries, become part of the dietary of all classes. In the farming of the country these changes are reflected in the increased production of live-stock products at the expense of cereals, and in the growth of market gardening and fruit production.

Apart from increases of population, the demand upon production from the land is increased rather than diminished by this alteration in the standard of living. As the collective demand shifts from cereals to meat and the corresponding shift in relative prices induces farmers to convert their cereals into meat, the total draught from the land is increased, because the gross nutritive power of the meat is much less than that of the cereals from which it was manufactured. In an ordered national economy, if such a thing is feasible, in a state organized for efficiency like an engineer's layout, there is a clear gain of man-power when as small a proportion as possible of the population is engaged in the prime business of producing the food the community requires. Probably 10 per cent. of the population could do this under organization, and yet maintain the existing standard of living. But the vision of an ordered world is very far away; at present most statesmen in the world are intent upon reserving the peasant population and on maintaining, if not increasing, the number of men living on the land. The present population constitutes a stable element in the community, one that is socially valuable in many ways. A peasant population even the old rural communities which have so very largely perished in Great Britain, has a social organization, "a culture" of its own which very few people wish to exchange for the amorphous aggregates of wage-earners characteristic of the great industrial towns. So the small farm is protected even at the cost of dearer food for the rest of the community. The alternative of a reconstruction of the land system is too gigantic a task for any statesman to contemplate; few people care to contemplate social revolution on Russian lines.

But ultimate economy of production lies with the large organized farm, and economic pressure ultimately and, however slowly, has its way. In the past it has tranformed the mediaeval land system of England with its open fields and common farming into private ownership and agricultural units of moderate size. It is not to be supposed that such change is at an end, but it may be presumed that as it arises in response to economic pressure it will be a gradual transformation, without sudden dislocation or hardship to any considerable section of the people. Political action may at times accelerate and at times delay, but the course of English history leads one to anticipate that it will do little more than register the changes that have already taken place in men's opinions and mode of living.

SOME FACTORS IN THE MANURING OF COFFEE*

DURING the past five years there has been a considerable increase in the use of both organic and artificial manures for coffee. In some cases, either there has been no evident response at all, or it has appeared that the application has been detrimental. In most of these a closer examination of the soil conditions reveals the reason.

In soils in good heart, i.e. well provided with humus, not eroded, and which work easily, satisfactory results are obtained. In such soils there is generally a supply of available nitrogen adequate to the needs of both crop and of the green manure, whether this be specially planted or just weed growth. Unfortunately, on many plantations the soil can by no means be described as being in good heart. Years of clean cultivation may have reduced the humus content to a dangerous degree or wash may have removed the rich soil. Under such conditions, unless care be taken in the selection of a manure and in its application the results may be most disappointing, and perhaps, the manure will appear to have a definitely adverse effect on the crop. Cases have been observed where the soil has become so impoverished that it was incapable of carrying more than a meagre weed growth, the application of single or unbalanced manures have had little effect beyond a slight improvement in the growth of the weeds. Such results tend to make the planter wonder where lies the vaunted benefit of manuring. Proper selection and application of manures would probably have given such results as would have made him an enthusiastic user of manures.

On soils in bad heart, prepared organic manures are the first that should be applied. It would be unwise on land hardly capable of carrying weeds to attempt the amelioration of the soil by means of green manures alone. A legume may, if manured with a fertilizer mixture supplying phosphate and potash with a little nitrogen, produce a good bulk of organic matter, but when turned under, unless a dressing of readily available nitrogenous manure be given simultaneously, there will be such competition for the available nitrogen in the soil by the microbes responsible for the rotting that the coffee will suffer severely. There will be yellowing of the leaves, probably followed by "die-back". The use of a non-leguminous green manure, unless great care be taken, will almost certainly cause die-back. If it be possible, prepared organic manure only should be used.

In order to obtain the best results from the dressing, the mode of application must be considered carefully. The application of surface dressing of even as much as ten tons per acre of well rotted manure to an impoverished soil may have very little effect upon the immediate crop. Much of the value of the manure is missed by the roots. A mass application is more economical, and will produce much more marked results; by this term is meant the application of the manure in a small pit, the bottom of which is 15 in. to 18 in. down, or in the bottom of a furrow 9 in. to 12 in. deep. In the writer's opinion, on a badly impoverished soil the latter method is the better to employ, the former should be

* By V. A. Beckley, M.C., M.A., A.I.C., Senior Agricultural Chemist—in Bulletin No. 16 of 1932 of the Department of Agriculture, Colony and Protectorate of Kenya.

used on soils in better heart and to follow the pit method in the reclamation of poor soils. A most interesting experiment was observed illustrating the benefits of the pit method. On a portion of one block of coffee, a dressing of five tons per acre of well rotted manure had been applied broadcast and harrowed under. On the rest of the block a similar application had been made in pits. Where the surface application had been given there was no visible result, the trees were in poor leaf, and generally looked in poor condition. Where the manure had been applied in pits there was a most marked improvement. In the one case there were few fine feeding roots; in the other the whole mass of manure was filled with feeding roots.

The question will be immediately raised as to the advisability of concentrating feeding roots in one place. It most certainly is wrong, especially in areas of low rainfall, but it is not suggested that the treatment should stop here. In the following years pits should be dug and filled on the other sides of the tree, so as to form more masses of rich soil. These may be joined up later by furrows into which the manure is placed. In the course of a few years the plantation will have a lattice work of deep rich soil, and in addition every bit of manure will have directly benefited the trees. Had the surface applications only been made, it is certain that the effect of the manure would have been much less.

As the establishment of the lattice work of rich soil proceeds, one can begin to consider the general amelioration of the soil by means of green manures which have received artificials. It is considered that at first only leguminous green manure crops should be used. Even these at the beginning, when turned under, may need a little nitrogenous manure to help the decomposition. Most of this nitrogenous manure will be locked up and added to the reserves of the soil, slowly to be drawn upon later. As the soil condition improves, the application of organic manure may be in the form of surface dressings, and if required non-leguminous green manures may be introduced.

It is granted that the system proposed has many faults, but in order to obtain the same effects in the proper way annual broadcast dressings of about twenty tons per acre would have to be given, and these are quantities that very few planters have available. They are lucky if they have five tons per acre available. The method proposed is economical, and does enable the coffee to obtain the maximum benefit from the manure. Again, it must not be thought that this method is intended to be used everywhere. It is proposed for soils where for some reason or other the humus supplies are low. Where the soil is in good condition, surface broadcast dressings should be applied so as to maintain the humus supplies and reserves of plant nutrients.

There is another factor to be considered in the application of organic manures, and this is the nature of the manure. Composed and properly prepared farmyard manure in the early stages of their preparation contain a fair amount of long-fibred undecomposed cellulosic material. In this stage it is spoken of as being "long". When the decomposition is far advanced, practically no long-fibred material will be found. In this state manure is spoken of as being "short". In heavy compact soils "long" manure should be used. The long pieces of cellulosic material when they decompose leaves channels in the soil, thus opening it to the freer movement of air and water. Coffee soils definitely requiring "long" manure are not general in Kenya. Perhaps the only part where these are at all common is in the Nyanza Valley. The use of "long" manure would not be detrimental on many of the Kikuyu red loams. On many soils "long" manure would be detrimental. These are the lighter sandy soils, where the movement of air and water especially is already too free. The provision of long channels would

carry water through the soils too readily. Light soils need "short" manure to supply cementing material to make them less liable to pack under rain and less liable to form plough sole pans. Such soils occur in much of the Trans Nzoia, the Mua and Ithanga Hills, among other places.

In this connexion, the effect of humus upon soils which are apt to run together and form pans under cultivation may be stressed here. Such soils contain large proportions of fine sand, which when in the single grain condition is very apt to run together to form a hard almost impenetrable bricklike formation. Humus costs the particles of fine sand, cementing them into irregular masses consisting of many individual grains. These irregular masses are not apt to slip over each other; consisting of particles firmly cemented together, they resist slipping movements and prevent pan and cold formation. The water-retaining capacity of the soil is also increased. In these light soils, the oxidation of humus is very rapid indeed, which is one explanation of their high productivity when virgin and the rapid loss of fertility when cultivated for a few years. It is essential for planters on these soils to make every effort to maintain the humus content of their soil at a high level, both to maintain fertility and to preserve their soils in a workable condition.

During the past year or two, reports have been received regarding the difference between the effects produced by bone meal and superphosphate upon soils in poor condition. The bone meal has given a marked effect, the superphosphate none or very slight. There are two factors arising here. It has been forgotten that although bone meal is primarily a phosphatic manure, it also supplies a certain amount of nitrogen in a form that is fairly readily rendered available. In many cases it is this small extra supply of nitrogen that has made the difference. The other factor lies in the fact that in raw soils, soils which have suffered wash and the subsoil is exposed or in which the humus content has been depleted, there is a liability for the soluble phosphates, to be locked up in a highly insoluble form. Superphosphate contains a great deal of soluble phosphates, and probably much of this would be lost on a soil in really poor condition. In bone meal the phosphate is present in an insoluble form, which is readily rendered available for plant use, but is not so liable to be converted into the highly insoluble form. On acid soils in really poor condition a dressing of bone meal will supply more phosphate to the coffee than an equivalent dressing of superphosphate.

If one must attempt to grow a green manure crop on a poor soil to try to improve the soil, using artificials to assist the green crop, there is more likelihood of success if a bone meal-potash mixture is used to fertilize the green manure than if a superphosphate-potash-sulphate of ammonia mixture be used. In passing, it should be stated that one is more likely to obtain a good growth of green manure under these conditions if the green manure be given a dressing of an organic manure broadcast between the rows.

Although there is a danger of soluble phosphates being lost in an acid soil, the amount lost in such a soil rich in humus is so small that this disadvantage is completely outweighed by the advantage of having a very soluble phosphate. One of the most marked responses to both nitrogen and phosphate in coffee seen by the writer was due to an application of a completely soluble ammonium phosphate. Until evidence to the contrary is adduced, those whose soils are well provided with humus need have no

qualms regarding the use of superphosphate or any of the other soluble phosphates. Where, however, the soil is poor in humus, whether due to neglect, cultural conditions or natural conditions, the use of superphosphate is apt to lead to losses of phosphate and the less soluble phosphates such as bone meal and ground rock phosphates are to be used. An investigation is in progress to ascertain as far as possible what happens to various phosphates in soils in different stages of deterioration.

As regards potash, it would appear from analyses that Kenya soils are, generally speaking, well supplied. It does, however, appear that most of this potash is either present in a form unavailable to plants or is so tightly retained by the soil particles that the plants are unable to obtain an adequate supply of potash, as symptoms which the writer associates with a potash deficiency are very common in coffee. After an application of potash these symptoms disappear. The coffee crop, too removes a large amount of potash from the soil. Even though one does not see a marked response in the appearance of the bush, it is considered to be a good practice to apply annually dressings of a potassic manure.

Some curious methods of applying manures, especially artificials, have been observed. When first artificials were used in Kenya, the writer stated they should be applied beyond the drip of the tree, in contradistinction to under the tree. In some cases artificial fertilizers have been applied in a narrow trench dead along the drip line of the tree. In others they have been distributed in a thin line on one side of the tree. These methods are very inefficient. The dressing should be made between the rows broadcast, so as to economize in labour, to secure a good distribution, and also to prevent any over-concentration of soluble materials which may injure the roots. Of course, when the trees grow so that the ground is almost completely shaded, it will be necessary to scatter manure within the drip of the tree, but at the same time there must be no attempt to concentrate the fertilizer around the trunk of the tree. It must be well distributed.

Of the artificials, only the purely nitrogenous may be applied as a top dressing. In these the nitrogen is rapidly converted into nitrates which are very readily washed down to the feeding roots and beyond. Both the phosphatic and potassic fertilizers are retained almost where applied; they move downwards very slowly indeed. Dressings of these manures should be turned under on application. One cannot say definitely what is the best time to apply manures and fertilizers that require turning in. So many factors have to be considered, one of the most important of which is damage to the roots. We do not know yet when the root growth is most vigorous, whether it is related to the state of the crop or to the weather, or if both affect it. The subject is being studied by the coffee section at the Scott Agricultural Laboratories. Their findings will be of great value in determining what is the most suitable time to apply fertilizers. All one can say now is that probably the best time is before the rains in between crops. Seriously to damage the fine roots which carry the feeding rootlets of a bush carrying a large crop is courting trouble. A tree carrying a crop is under a heavy demand, and from the roots both stored food and plant nutrients are being obtained. Severe damage to roots interferes with the supply of both, and tree and crop suffer. In between crops, shortly before the rains are expected, probably the damage done by root cutting will be at a minimum, also it will be more transient; with the advent of rains the cut roots will be stimulated to produce further growth.

Nitrogenous artificial manures, if the most lasting effect is to be obtained, should not be applied until near the end of the rains, with certain exceptions. The artificial nitrogenous manures are urea, salts of ammonia and nitrates. The first two are not immediately available to the plant; they are converted by soil microbes into nitrates. Nitrates are not retained by the soil, but are readily washed out. If nitrogenous artificial fertilizers are applied at the beginning of the rains, the greater part will be washed away from the feeding roots before they have been able to make much use of them. The only times when quick-acting nitrogenous manures should be applied at the beginning of the rains is when there is a definite need for nitrogen, such as severe yellowing, or when a heavy crop of weeds or non-leguminous manure has been turned under in a soil rather deficient in nitrogen. It should be taken as a general rule that quick-acting nitrogenous fertilizers should only be applied towards the end of the rains. Downward movement of nitrates will largely be balanced by subsequent upward movement as the surface soil dries.

The more slowly available nitrogenous manures, such as boma manure, composts, meat meal, bat guano, etc. do not suffer to the same extent as the quick-acting manures from loss by leaching. The nitrogen is only gradually rendered available, and although a great deal of the available nitrogen produced may be lost during the rains, it is only a small portion of the whole. Slowly available nitrogenous manures are generally the most suitable for permanent crops such as coffee.

In conclusion, the writer wishes to impress upon planters that while a general programme of manuring may be drawn up, a detailed programme, taking into account these minor but nevertheless important factors, will require close study of the conditions in the plantation. Application of a general programme of manuring without consideration of details may lead to unsatisfactory results. It is here that the planter's own knowledge of the conditions existing in the plantation must be used.

THE TOBACCO STEM BORER*

COMPARISON BETWEEN STEM BORER AND LEAF MINER

THE tobacco stem borer, *Phthorimoea heliopa* Low., is a close ally of the tobacco leaf miner, *P. operculella* Zell., already familiar to most growers. The two moths are moulded to the same generic pattern, being alike in size and with the habit of folding their wings roofwise when at rest. In freshly emerged specimens the colour differences are distinct, heliopa having the wings suffused with a brick-brown colour which contrasts strongly with the white flecked grey typical of the better known species. When specimens of each are collected in the field, they are, however, much the same in appearance. The scales responsible for the colour have been partly shed, and with them many of the distinguishing features. Hence there is a widespread confusion between the two forms, a confusion which is accentuated by their association together in the field. Perhaps this may explain the non-recognition of the pest previously, though tobacco has been grown for many years in Australia. Both species have been reared from the stems of plants which have collapsed in the field, and such losses can best be assigned to one or the other pest by the generalisation that superficial sub-surface burrowing is due to *P. operculella*, while core injury proper is caused by *P. heliopa*.

NATURE OF STEM BORER INJURY

The injury may be considered in the two aspects which most concern the grower, the first dealing with the insect's activity in the seed-bed. Here the early indications of trouble may be seen in several of the seedlings showing tip malformation. The centre leaves do not unfurl in the usual way; they may be undersized, but more often are merely malformed as if the growth vigour of the plant was insufficient to effect its ordinary unfolding and spread. When infested seedlings are removed from the seedbed for examination their stalks will be found to be distended into galls, each of which harbours a single larva of the moth. These galls usually, but not necessarily, lie near the tip of the plant. The obvious interference with the ordinary development of the growing point leads to secondary suckering, the suckers being thrown from the leaf axils below the swelling in the stem. In the ordinary course of transplanting, such plants are usually discarded, but their rejection gives no guarantee that the remainder of the seedlings are free from infestation. A gall of visible dimensions is produced only when the larva within is more or less mature, hence seedlings taken from beds with only a sprinkling of galled plants may not only carry the eggs of the moth, but also young larvae within the tissues, too small as yet to induce obvious gall formation. Such plants seldom flourish in the field. Sooner or later the main growing point is destroyed and the control of supplementary sucker growth from the lower parts of the stem compels considerable pruning at the expense of much labour. Though a crop may ultimately be harvested from such plants, it rarely has the uniformity which is considered so desirable in the field.

Attacks are, however, not limited to the seedbed, for plants may be perfectly free from the pest when set out in the field and yet succumb later on. Should the field infestation take place at an early stage, the plants react in much the same way as has been described for the seedlings.

* By J. Harold Smith, M.Sc., Entomological Branch in *Queensland Agricultural Journal*, Vol. XXXVIII, Part 4, October 1932.

Should they be firmly established, the larvae may develop freely within the stem without affecting the tip of the plant or causing obvious sucker growth. The mechanical disability suffered by the plants in such cases may not in itself be considerable, but too often the attack opens the way for saprophytic fungi, which may rapidly invade the healthy tissues of the stem and sooner or later induce the general collapse of the plants. Pith infestation is most common in replants growing amongst an already heavily infested crop, and this suggests that resistance to new attack increases with the age of the plant. Attacks shortly after transplanting are consequently most to be feared, as they predispose the plants to general collapse, which follows the local injury caused by the larvae and the fungal activity which it initiates.

LIFE-HISTORY

The life history follows more or less that of the better known tobacco leaf miner. Oval eggs, white in colour, and ornamented with reticulate surface sculpturing, are laid singly on either stem or leaf surfaces. Larvae emerge from these in a week or so—observations are limited to the summer months—and shortly commence to burrow into the stem of the plant. Subsidiary mining of the leaves preparatory to stem boring has been recorded from other countries, and this phenomenon has also been seen here. The majority of the burrows are initiated near the axils of the leaves under the shelter of their extensions at the point of insertion to the main stalk. The nature of the burrow depends entirely on the maturity of the host, and may thus be a localised gall-like excavation, such as that described from young plants, or a wandering burrow which widens as the occupant grows. Several larvae may be found together in the one plant. The larval period is completed in about four weeks. When full grown the larva hollows out a cavity abutting on to the surface of the plant, an exit hole is made, and both it and the cavity are sparsely lined with silk. In this chamber pupation takes place, the adult emerging in some eight days.

In thus pupating within the stem, the tobacco stem borer differs from its close ally, the leaf miner, for the latter ordinarily leaves the host plant in the last larval stage and completes its development in the ground or, if on the plant, within the shelter for decaying leaf fragments.

Little precise information is available regarding the seasonal activity of the pest or the duration of its several stages. Apparently the female moth is capable of laying in the vicinity of one hundred eggs, these being laid irregularly over a period of three weeks. The whole life cycle occupies some six weeks, while the independent adult life is by no means brief for adults have been kept alive without food for a month. Hence it may be safely conjectured that several generations occur in the year, these overlapping one another.

CONTROL MEASURES

With pests of this kind, control measures of any one type are not altogether satisfactory. Sprays afford no apparent relief for the burrowing habit takes the larva beyond the reach of either stomach poisons or contact sprays very early in its life. Recourse must therefore be made to the influence of several farming practices on the pest.

Seedbed injury usually appears most significant to the grower's eye, for an epidemic phase of moth activity may ensure the wholesale destruction of his plants. As the moth is on the wing during the late afternoon, some growers have attempted to cope with them by fastening down the hessian storm covers daily about 3 p.m. The method may help, but in itself is insufficient to exclude the moth from the beds altogether should the insect population be above normal. A better method would provide for their total exclusion from the beds, if the anticipated moth infestation promises to be considerable, the advisability of the practice depending entirely on the

general field losses during the previous season. Total exclusion could be effected by double covering the beds. Either stockinette or a mosquito-net material would serve as a first cover, this being stayed to the sides and ends of the beds and to be regarded as permanent. In practice it would prove most convenient to fasten one side and have the other attached to a running pole which could take up an accumulated slack. Watering should be carried out through the stockinette. The usual hessian cover in general use as a protection against storm waters—so common during the later months of the year—would provide additional protection when necessary. With the dual device, plants may be raised free from lepidopterous pests up to the transplanting stage.

Cultural practices may be of material assistance in keeping the moth population down to manageable proportions. It is presumed on fairly sound grounds that the moth has few indigenous host plants in the immediate vicinity of the major tobacco districts. Hence were the infestation of the growing crop limited to adults wintering on these, the actual loss would be inconsiderable. In practice, however, laxity in the removal and destruction of volunteer plants and residual stalks remaining in the field creates a fund of additional breeding material in which the pest may continue to thrive. Growers ought therefore to uproot all the plants in a cultivated area as soon as practicable once the leaf is removed in an endeavour to eliminate unnecessary breeding material. These plants have to be removed in any case before planting can be resumed in the following season, hence no additional labour is involved in the process. Ordinarily these uprooted plants will dry out rapidly if exposed to the sun and will be entirely unsuited for the further development of most of the larvae which they contain. Those approaching maturity will shortly pupate and complete their development, but others will doubtless be destroyed. With the general adoption of such clean up measures, the interim between the completion of harvesting and the commencement of the next season's planting should be sufficiently long to kill off the majority of the moths, in spite of their comparatively long adult life.

Where irrigation facilities are available, growers may be tempted in frost-free districts to grow a winter crop immediately after the summer leaf is harvested. In an area free from the stem borer the venture may be quite successful, but this pest can easily upset calculations. The incidence of this and allied insects in second crops is invariably greater than that in the first—a natural consequence of rapid reproduction when the food supplies are ample. Consequently multiple cropping should only be proceeded with when the significance of the pest fauna and the practicability of its control under epidemic conditions has been thoroughly realised. It may be found later that the stem borer alone will make the practice uneconomical in the major tobacco districts.

Once plants in the field are affected, much can be done with the judicious use of the knife to ensure a crop. If the growing point is affected, the plant may be cut back to a sucker in the axil of a lower leaf, which will then function as the tip of the plant. Given subsequent freedom from heavy infestation, a crop may thus be assured, while, even if minor attacks do follow, the plants may be sufficiently hardy to grow normally. Galled tips removed from the plant in the process should in all cases be collected and destroyed.

From the foregoing discussion of control methods it will be obvious that the suggestions merely conform with the requirements of good farming, varied to meet the problem raised by the advent of, perhaps, the most serious of pests into tobacco districts. Eradication of the insect is quite impossible; control is a reasonable probability, and the latter is the goal at which growers must aim.

MEETINGS, CONFERENCES, ETC.

THE COCONUT RESEARCH SCHEME (CEYLON)

BOARD OF MANAGEMENT

Minutes of the 18th meeting of the Board of Management of the Coconut Research Scheme held in Room No. 202, New Secretariat, Colombo, on October 24, 1932.

Present.—Dr. W. Youngman, (in the chair), Mr. J. Fergusson, Sir H. Marcus Fernando, Messrs. J. L. Kotalawala, M.S.C., C. W. Bickmore, C.C.S, (Acting Financial Secretary), G. Panditteseker, J.P., U.P.M., S. Pararajasingham, J.P., Gate-Mudaliyar A. E. Rajapakse, M.S.C., and Mr. A. W. Warburton-Gray, J.P., U.P.M.

Dr. R. Child, Chief Technical Officer, also attended the meeting by invitation.

MINUTES

The minutes of the 17th meeting of the Board of Management held on September 7, 1932, were confirmed.

The Chairman reported with regret the death of Mr. G. E. Madawela, and moved that the sympathy of the Board be recorded.

FINANCE

The draft Estimates of Income and Expenditure for the year 1933 which had been circulated to members were considered in detail. The first instalment of one lakh of the Government loan of two laks had been received and that the second instalment of Rs. 50,000 which the Board was hoping to receive next year was shewn in the Capital Account; it was hoped that the Board would not require the further sum of Rs. 50,000 to which it was entitled. The loan had to be repaid with interest.

It was agreed that the item under apparatus and books should be shewn in the expenditure account rather than under capital account because it was not a capitalised item.

With regard to the item for a jungle area for nursery work it was explained that the matter was under correspondence.

The Board agreed to items for the Office with an additional sum of Rs. 300 for a telephone installation on the estate which the Board thought was essential.

Items under Estate were agreed to with the addition of Rs. 3,500 on the estimate for manuring.

Mr. S. Pararajasingham said that provision should be made for drainage and soil erosion measures on the estate. Dr. Child promised to furnish details with regard to these matters for the next meeting of the Board.

The statement of receipts and disbursements for the quarter ended September 30, 1932, which shewed a cash balance at that date of Rs. 83,866·09, was passed.

The transfer of a sum of Rs. 75,000 from current account to fixed deposit was approved by the Board.

STAFF

Mr. J. L. Kotalawala thought that the Technological Chemist should concentrate his attention on possible new uses of coconut products. It was understood that such work certainly formed part of the Chief Technical Officer's work but could not be undertaken until the completion of the laboratory. After general discussion it was decided, on the proposition of Mr. J. Fergusson, seconded by Mr. S. Pararajasingham, that the present arrangement with the Technological Chemist as Chief Technical Officer of the Scheme be continued and that a Soil Chemist, to be a full time officer, be appointed when the laboratory was ready. It was further decided to appoint assistants to the Technological Chemist and the Geneticist on completion of the laboratories, together with laboratory attendants for each laboratory. It was decided to appoint a mechanic to look after the machinery on the estate, and a junior assistant.

MINISTER OF AGRICULTURE'S MEMORANDUM ON MARKETING OF COCONUT PRODUCE

It was decided that as the matter did not come under the purview of the Coconut Research Scheme Ordinance it should be referred to the Planting Associations including the Low-Country Products Association, and a reply sent to the Minister to this effect.

ESTATE

Estate. The Estate Progress Accounts for August and September were placed before the Board as Circulation Papers Nos. 91 and 92. These were passed.

BOARD OF AGRICULTURE

ESTATE PRODUCTS AND FOOD PRODUCTS COMMITTEES

Minutes of the Fifty-third Meeting of the Estate Products Committee and the Seventeenth Meeting of the Food Products Committee held jointly at the Board Room of the Board of Agriculture at 2 p.m. on Tuesday, November 8th, 1932.

Present:—The Director of Agriculture (*Chairman*); the Hon'ble the Minister for Agriculture and Lands; the Government Mycologist; the Government Entomologist; the Agricultural Chemist; the Economic Botanist; the Divisional Agricultural Officers of the Northern, Eastern, Southern, South-Western, and North-Western Divisions; the Director of the Tea Research Institute; the Director of the Rubber Research Scheme; the Chief Technical Officer of the Coconut Research Scheme; Sir Henry L. de Mel; Sir H. Marcus Fernando; the Hon'ble Mr. M. M. Subramaniam; Gate Mudaliyar G. A. Goonetilleke; Mr. S. Muthuthamby, District Adigar; W. A. Udugama, Dissawe; Rev. Father L. W. Wickramasinghe; Mudaliyar C. Rasanayagam; Mudaliyar S. M. P. Vanderkoen; Messrs. John Horsfall: H. D. Garrick; L. F. Roundell; R. P. Gaddum; T. J. Wilson; J. B. Coles; F. A. E. Price; C. A. M. de Silva; T. Sathasivam; A. W. Warburton-Gray; A. Ramanathan; A. A. Wickramasinghe; S. Pararajasingham; N. D. S. Silva; G. B. Foote; C. Drieberg; G. Pandittasekera; H. A. Webb; J. P. Blackmore; A. T. Sydney-Smith; J. W. Ferguson; J. Carson-Parker; V. A. de Mauny; E. C. Villiers; C. H. Wilkinson; B. M. Selwyn; R. Smerdon; Wace de Niese; F. R. Dias; J. Fergusson; A. G. Baynham; J. Forbes; Mudaliyar N. Wickramaratne (*Secretary, Food Products Committee*); and Mr. T. H. Holland, (*Secretary, Estate Products Committee*).

Visitors:—Lieut.-Col. T. Y. Wright; Messrs. J. C. Drieberg; G. D. Austin; F. J. Fernando; C. N. E. J. de Mel; W. C. Lester-Smith; F. F. Jepson; E. J. Seneviratne; V. Canagaratnam; J. E. Tull; J. D. Aitken; L. Row; M. P. Fraser; E. Neville-Rolfe; and T. Eden.

Letters or telegrams expressing regret at inability to attend were received from Sir Solomon Dias Bandaranaike; the Government Agent Southern Province, Mr. C. W. Bibile, R.M.; Messrs. J. H. Titterington; G. R. Whitby; C. Muthiah; T. B. Wettewe; W. H. Field; and A. Mahadeva.

AGENDA ITEM 1. CONFIRMATION OF MINUTES

The minutes of the last joint meeting of the two Committees, having been circulated to members, were taken as read and confirmed.

At this stage Mr. A. G. Baynham asked if items 9 and 10 could be taken earlier in the agenda since a number of planting members, who were especially interested in these subjects, would have to leave early to attend another meeting.

Mr. Webb, the introducer of items 5, 6, 7, and 8, having assented to this alteration, the Chairman agreed to take items 9 and 10 together after item 3.

AGENDA ITEM 2. PROGRESS REPORTS OF THE EXPERIMENT STATION, PERADENIYA, FOR THE MONTHS OF JULY AND AUGUST, AND SEPTEMBER AND OCTOBER, 1932

The Chairman invited comments on these reports.

Mr. Smerdon asked if it was a new departure to publish yields of coffee in fresh berries, and what was the out-turn of market coffee.

Mr. Holland replied that coffee yields on the Experiment Station had always been published in fresh berries and that the out-turn of parchment coffee was about 22 per cent.

Mr. Carson-Parker enquired if all the *Indigofera* in the tea plots had been killed out by the manure applied.

Mr. Holland replied that the cover had only been killed in the alternate rows to which Nicifos had been applied, and that a satisfactory fresh cover had been formed from self-sown seed.

Mr. Selwyn made an inquiry about the length of time some rubber buds on the Iriyagama Division had taken to shoot, and asked if there was any method by which the shooting of rubber buds could be accelerated.

Mr. Holland said that he had known a bud to take 10 months to shoot. He explained a method advised by Mr. C. E. A. Dias to accelerate the shooting of buds.

Mr. Foote gave an instance of a bud which had taken two years to shoot.

Mr. Gaddum enquired when the results of the soil erosion experiment referred to in one of the reports would be published.

The Chairman replied that the article containing these results would be published in due course if considered suitable.

Mr. Foote contended that the Committees had a right to demand the publication of the results of the experiment and asked for an assurance that they would be published.

The Chairman promised Mr. Foote that the reults would be made available to him but stated that as Editor of *The Tropical Agriculturist* the privilege was his to determine whether or not any article should be published in that journal.

Mr. C. A. M. de Silva asked why the fodder grass known as Guinea Grass "A" had been uprooted if the growth was so vigorous.

Mr. Holland replied that it was uprooted because it had become a noxious weed. The grass was very coarse and was no easier to cultivate than the better variety known as Guinea Grass "B".

Mr. Carson-Parker made some inquiries about the number of bushes in the tea plots lately under the *Indigofera* trial.

Mr. Holland replied to these inquiries.

The two reports were then adopted.

AGENDA ITEM 3. THE PRESENT POSITION OF COCONUT CULTIVATION

Sir Marcus Fernando read a paper entitled "On the Present Position of Coconut Cultivation in Ceylon and how it may be advanced by the growing of Bye-products side by side of the Main Industry".

The Chairman thanked Sir Marcus for his interesting address and said he was glad to note the tone of optimism which pervaded it,

AGENDA ITEMS 9 AND 10. THE PARTIAL REPLACEMENT OF ARTIFICIAL MANURING OF TEA BY GREEN MANURING; AND THE RELATIVE VALUES OF ORGANIC AND INORGANIC FERTILISERS, THEIR RELATIVE EFFECT ON THE QUALITY OF THE TEA, AND THE USE OF SMALL APPLICATIONS OF EITHER WITH A VIEW TO REDUCING THE COST OF TEA CULTIVATION IN THE PRESENT CRISIS

Mr. C. H. Wilkinson first spoke on item 9. He emphasised the importance of green manuring and suggested that the study of this branch of agriculture was still in its infancy in Ceylon. He gave a brief outline of early methods and plants used and of the changes in procedure which had gradually been adopted. He questioned the correctness of some methods now employed and suggested the advisability of adopting more widely a system of growing green manure plants in ravines and elsewhere and carrying the green material on to the tea land, thus adding an entirely fresh supply of nitrogen and other plant food ingredients.

Mr. Sydney-Smith then spoke on item 10. He said that the burning points in tea planting at the present time were economy and quality. His object was to elicit information on how the cost of manuring could be reduced, and on the effect of manuring on the quality of tea. He said that the evidence on the latter point was contradictory—some highly manured estates were still doing well but on many others, similarly treated, prices were deplorable. He enumerated the factors which were known to effect quality—climatic influences, rapidity of growth, fine plucking, and the time after pruning that the leaf was plucked.

He referred to Dr. Joachim's work on the availability of manures and hoped that further progress had been made on these lines. He pointed out the great saving effected by the use of inorganics but said that many experienced planters still used organic manures. The quick response to applications of some inorganic manures indicated forced growth likely to result in poor quality. He quoted an instance of falling off in yield and appearance after a quick response to an inorganic manure but said that when the use of the old organic mixture was resumed the tea improved. These contradictory results demonstrated the need for an authoritative scientific opinion. No one wished to use an expensive organic manure if equally good results could be obtained more cheaply with inorganics. He enquired if small doses giving perhaps only 10 to 15 lb. of nitrogen per acre would be likely to be of value. Much also depended on green manuring but Mr. Wilkinson had dealt with that question.

Dr. Joachim dealt first with the question of green manuring. There were two systems -growing the green manures on the land, and, bringing in the material from outside. The growing of non-leguminous plants on the land resulted in no gain in plant food, though possibly there might be a gain in organic matter and an improvement in the physical condition of the soil. The growth of leguminous plants *in situ* resulted in some gain in nitrogen, provided that the plants developed nodules, but no gain in phosphoric acid and potash. He explained the significance of the carbon-nitrogen ratio in green manures and in the soil and pointed out that the addition of green material to the soil might result in some loss of carbon unless additional nitrogen was supplied in the form of a concentrated artificial fertiliser such as cyanamide. He referred to an experiment now in progress at Peradeniya on this question. Referring to Mr. Sydney-Smith's question he pointed out that the maximum nitrification period for

both organic and inorganic manures was about 6 to 8 weeks and further that the quantity of organic matter supplied by organic manures was usually insignificant compared with the quantity already found in the soil. The necessary organic matter could be added in the form of green material.

Mr. Eden emphasised that it was impossible to preserve nitrogen in the soil unless one also preserved carbon. The easiest way to do that was by the burial of green material. There was a surplus of carbon in green manures and this should be preserved by the addition of nitrogen to the soil. There was proof from well authenticated experiments that the micro-organisms which fixed nitrogen in the soil preferred inorganic to organic nitrogen. He said that there was as yet no reliable evidence in Ceylon on the relative value of organic and inorganic manures but that experiments had been in progress for two years which would eventually furnish information on this question. He referred to a Rothamsted experiment in which rape cake had, over a large number of years, given a higher yield of mangolds than sulphate of ammonia but explained that this was largely due to the improved tilth and therefore better germination of mangold seed resulting from the use of rape cake. On the other hand, in a similar experiment with Barley in which half the quantity of rape cake was applied sulphate of ammonia had given slightly superior results. He suggested that a possible reason for the preference for organic manures was that formerly the difference in the unit value of nitrogen in the two kinds of manures was very much less than at present. He gave it as his personal opinion that if full use was made of green manures there was little risk of loss of crop through changing over from organic to inorganic manures. The question of quality was being investigated by the Tea Research Institute. Brokers had been unable to distinguish between teas which had received 40 lb. of nitrogen per acre and those which had received none. He thought that quality was more likely to be affected by the amount of nitrogen applied than by the kind of nitrogen.

Mr. Wilkinson said that the opinion was widely held that soluble manures had a deleterious effect on quality.

The Chairman thanked members for their contribution to a very interesting discussion.

AGENDA ITEM 4. FACILITIES FOR VILLAGE TEA CULTIVATORS TO DISPOSE OF THEIR PRODUCE

In the absence, through ill-health, of Mr. Wettewe, the introducer of this item, the subject was not taken up.

AGENDA ITEM 5. THE ORGANISATION OF SUPPLIES OF CEYLON RICE FOR PURCHASE BY ESTATES

Mr. Webb said that it was contended that Ceylon should be self supporting in its rice supplies but that if estates were to buy Ceylon rice it was essential that large quantities of a uniform quality should be available. He thought that the only way to achieve this was for Government to establish mills for the collection, milling, and sale of rice.

Mr. M. P. Fraser gave his experience in this connection. He said that through the assistance of three officers of the Department of Agriculture he had made arrangements to buy Ceylon rice for his labour force. He first purchased a supply from a rice mill at Anuradhapura but the rice was not up to sample, was full of stones, and of poor quality. He had then got into touch with a private grower in Batticaloa through the assistance of the Divisional Agricultural Officer. He had, however, failed to get any reply from this grower and the attempt had been abandoned.

Mr. Lord emphasised the difficulties involved. There was no rice mill in Batticaloa, rice was hulled by women, and there were considerable differences in the methods adopted. Also the threshing was done on sandy, stony threshing floors with the result that the rice was full of dirt and stones. Efforts were being made to improve conditions but there were many difficulties in the way. The only solution lay in the establishment of mills with modern machinery. Most rice hullers in Ceylon were of an out of date pattern.

Mr. Gaddum pointed out that the labour laws stipulated that labourers must be supplied with clean unblended rice.

Sir Henry de Mel thought that if and when planters were prepared to buy Ceylon rice adequate arrangements could be made. He said that rice had actually been supplied to a good many estates from mills at Kurunegala and elsewhere. A difficulty lay in the present cheapness of imported rice.

Mr. Garrick asked at what price Sir Henry de Mel could supply rice from his mill.

Sir Henry de Mel replied that rice could be supplied at about Rs. 10·70 per bag, and Muthusamba at Rs. 12·00 per bag. The difficulty was to buy enough paddy to keep the mill working.

Mr. Garrick inquired whether Tamil labourers liked this rice.

Sir Henry de Mel replied that they did not like it at first but were taking to it.

Mr. Fraser added that his labourers had liked it well enough, apart from the stones.

The Chairman agreed with Mr. Lord that the difficulty was largely due to obsolete milling machinery. It was intended to put up a modern rice mill in the near future.

AGENDA ITEM 6. WOODS SUITABLE FOR TEA CHESTS

Mr. Webb said that he had tried local tea chests for many years but they were unsatisfactory owing to different woods being used, tainting etc. He thought it was hopeless to attempt to revive the industry on the old lines. It was necessary to grow suitable woods on a large scale and to ensure that the wood was properly seasoned before use. He suggested that the Forest Department should set aside areas for growing suitable woods.

Mr. Jepson said that he had recently come into contact with this subject owing to the receipt of inquiries regarding the infestation of locally made chests by boring beetles. He thought the solution of this aspect of the problem lay in the prevention of attack rather than in after treatment. The use of properly seasoned timber and the rigid exclusion of unsuitable woods were also matters of importance. He thought that local makers of chests had failed to study the requirements of the trade and that as a result there had been a marked decline in the demand for locally made chests and an increase in the importation of foreign chests. He explained the essential requirements of a good tea chest. Although suitable trees abounded in Ceylon forests they were widely scattered and compact blocks of suitable trees were essential if a successful industry was to be established. This entailed extensive re-afforestation and there was little prospect of the demand being met locally for a number of years.

Sir Marcus Fernando said that the planting of large blocks of suitable trees had been recommended by the Industries Commission, on which he had served, many years ago.

Mr. Horsfall said he thought it would be worth while to enquire what New Zealand woods used for box making would grow in Ceylon.

The Hon'ble the Minister for Agriculture said that several New Zealand woods were already being tried.

The Chairman said that he took it that plywood chests were required and inquired from planting members if this was so. He described the method of making plywood and said the industry had been started in India.

Messrs. Forbes and Horsfall said that plywood was preferable because its lighter weight resulted in a saving in transport and freight.

Mr. Webb inquired whether Momi could be grown in Ceylon.

The Hon'ble the Minister for Agriculture said that experiments in growing Momi had not been very successful so far.

AGENDA ITEM 7. NEW PROGRESS IN THE MANUFACTURE OF TEA AND RUBBER

Mr. Webb inquired about the possibility of adopting new forms of manufacture for rubber.

Mr. O'Brien said that a good deal of interest had been shown recently in Dutch reports on the manufacture of powdered rubber. The Rubber Research Scheme were working on the same lines and Mr. Martin had in London evolved an alternative method for the production of "Crumb" rubber. The question was still in the experimental stage and the final results remained to be seen. At present there was no commercial demand for this type of rubber. He passed round samples of rubber prepared by these new methods.

Mr. Webb inquired if these new methods were more expensive than the standard methods.

Mr. O'Brien replied that he thought the preparation of such rubber would be more expensive than that of crêpe.

The Chairman asked if there was any difference between powdered rubber, "crumb" rubber and "foam" rubber.

Mr. O'Brien explained the differences and said that "foam" rubber was made by the Dunlop Company direct from latex by quite a different process to the other two.

Mr. Foote asked if Mr. O'Brien had anything more to report about unsmoked sheets.

Mr. O'Brien said that the experiments in unsmoked sheet had been carried out when the price of rubber was higher and firewood more expensive. As the price of rubber had now declined and firewood was very cheap the question was not attracting much attention. Unsmoked sheets would be more expensive to prepare than smoked sheets.

The Chairman asked if Dr. Norris had anything to say about new methods of tea manufacture.

Dr. Norris replied that he had very little more to report. The results obtained with the McKercher machine and the Lake cutter were so far discouraging. He was, however, surprised that the Marshall-Boustead chilled rollers had not attracted more attention. He had been considerably impressed with the results obtained with these rollers and thought that they should certainly have a future, especially in the low country.

Mr. Carson-Parker inquired about tea cider.

Dr. Norris replied that he had little to add to the published reports. A very palatable beverage could be produced and this was becoming popular with villagers in the Dutch East Indies where considerable quantities had been made.

Mr. Gaddum inquired if the beverage was intoxicating.

Dr. Norris said that the Java product contained under 1 per cent of alcohol.

Mr. Forbes said that he had recently returned from England where he had seen a good many samples of tea made by the McKercher machine. He was very unfavourably impressed with these teas which appeared inferior to those made on Mr. McKercher's own estate in India.

Mr. Garrick said that he had seen some very good samples of teas made with the McKercher machine and was sure that this or a similar system would eventually be widely introduced in Ceylon.

Mr. Wilkinson thought that teas made by this system would not stand a second infusion.

AGENDA ITEM 8. THE FORMATION OF A MARKETING BOARD

The Chairman first read a letter from the Ministry of Agiculture and Lands on the subjects of the formation of a marketing board and the report of the Committee on Soil Erosion. The letter indicated that the Ministry desired the Estate Products and Food Products Committees of the Board of Agriculture to submit a scheme for the formation of a Marketing Board for the consideration of the Executive Committee of Agriculture and Lands.

As regards the Report of the Committee on Soil Erosion the letter indicated that the Attorney-General and the Revenue Officers were being consulted in the matter and that as soon as these consultations were completed action would be taken.

The Chairman asked Mr. Webb if he had any suggestions to make on the subject of a Marketing Board.

Mr. Webb said that at the last meeting he had proposed that the Board should consist of two sections, one for local marketing and one for overseas marketing.

The Hon'ble the Minister for Agriculture said that he was in full sympathy with the idea. He said that a small Committee had already been appointed to inquire into local marketing. He would like to have the help and guidance of the Planting Associations as regards overseas marketing.

Mr. Smerdon suggested that it would be best to defer the question for a future meeting.

The agenda having been completed Mr. Smerdon inquired if it was intended to discuss the Minister's memorandum on the necessity for the reconstruction of the Board of Agriculture, copies of which had been tabled.

The Hon'ble the Minister said that he would welcome comments or criticism.

Mr. Smerdon suggested that the revenue district was too large an area for a district agricultural board and that conditions in a district might vary very much.

The Minister replied that the revenue district was suggested because it was desirable to have a responsible officer to take charge of the district boards and the Government Agent or Assistant Government Agent seemed the best person for this.

Mr. Warburton-Gray thought that there was no objection to the revenue district as a unit of area.

A discussion on the nature of the future board ensued.

Mr. C. A. M. de Silva suggested that the proceedings of the district boards should be in the vernacular.

Mr. Smerdon thought that it would be a good thing if the proceedings of the Committees of the present Board of Agriculture could be published in the vernacular.

The Chairman said that these proceedings in the vernacular were published in the *Govikam Sangarawa.*

Mr. Pararajasingham enquired whether the Minister wished the Estate Products and Food Products Committees of the Board of Agriculture to give their opinions on the constitution of a new board, if so a Sub-Committee should be appointed for the purpose.

Mr. Fergusson urged the appointment of a small Sub-Committee which would do the work much quicker than a large body.

The Chairman pointed out that the present meeting would probably be the last meeting held during the term of life of the present Board of Agriculture which terminated at the end of 1932. If a Sub-Committee were appointed to whom should its report be submitted ?

Mr. Wilkinson suggested that the two present Committees should meet again before the end of the year.

Mr. Wace de Niese said that the extinction of the present Board without an opportunity of expressing an opinion on the constitution of a future Board gave the opinion that the old Board had been a useless body.

Mr. Pararajasingham said he considered the present Board was fully representative and had a *right* to express its views on this subject and that another meeting should be held.

Mr. Foote thought that earlier notice of the demise of the present Board should have been given. He presumed that if the Ordinance was not amended before the end of the present year a new Board would automatically be elected in accordance with the terms of the old Ordinance.

The Hon'ble the Minister said that he personally thought that there was a need to reconstruct the Board but he did not know if his opinion would be shared by his Executive Committee or by the State Council.

Mr. Foote proposed and Mr. C. A. M. de Silva seconded that another joint meeting of the Estate and Food Products Committees should be held.

The Chairman said that as members had expressed a desire to discuss the Hon'ble the Minister's memorandum he proposed that the present meeting should be adjourned till some time early in December.

Mr. Wilkinson supported Mr. Fergusson's suggestion that a Sub-Committee should first be appointed to consider the memorandum and report to the adjourned meeting.

The Chairman asked the opinion of the meeting as to whether a Sub-Committee should be appointed or whether the question should be considered by the joint meeting of the two Committees to be held in December.

After some further discussion Mr. Wace de Niese proposed and Mr. Pararajasingham seconded that the Director of Agriculture should appoint a Sub-Committee to consider the memorandum and report to the adjourned meeting in December.

This proposal was put to the meeting and carried.

The Chairman suggested that the Sub-Committee should consist of five members of the Estate Products Committee and five members of the Food Products Committee.

This was agreed to.

The meeting then adjourned.

T. H. HOLLAND,
Secretary,
Estate Products Committee.

N. WICKRAMARATNA,
Secretary,
Food Products Committee.

ANIMAL DISEASE RETURN FOR THE MONTH ENDED 30 NOVEMBER, 1932

Province, &c.	Disease	No. of Cases up to Date since Jan. 1st 1932	Fresh Cases	Recoveries	Deaths	Balance Ill	No. Shot
Western	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	313	40	303	1	9	...
	Anthrax	...	...	...	...	...	...
	Rabies (Dogs)	24	1	...	2	...	22
	Piroplasmosis	...	...	...	...	...	...
Colombo Municipality	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	396	31	348	16	32	...
	Anthrax	30	1	...	30	...	...
	Rabies (Dogs)	32	8	...	...	...	32
	Haemorrhagic Septicaemia	...	...	...	...	...	...
	Black Quarter	...	...	...	...	...	...
	Bovine Tuberculosis	...	...	...	...	...	...
Cattle Quarantine Station	Rinderpest	.	...	...	...	...	...
	Foot-and-mouth disease	484		407	71	6	...
	Anthrax (Sheep & Goats)	476		...	476	...	...
Central	Rinderpest	1606	13	316	1248	10	32
	Foot-and-mouth disease	207	...	203	4	...	...
	Anthrax	...	...	...	...	...	...
	Black Quarter	8	...	...	8	...	...
	Rabies (Dogs)	1	...	...	...	...	1
Southern	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	32	...	32	..	..	...
	Anthrax	...	...	...	...	...	...
	Rabies (Dogs)	1	...	...	...	...	1
Northern	Rinderpest	16	10	1	14	...	1
	Foot-and-mouth disease	145*	...	139	6	...	...
	Anthrax	...	...	...	...	...	...
	Black Quarter	...	...	...	...	...	...
	Rabies (Dogs)	...	...	...	...	...	...
Eastern	Rinderpest	FREE					
	Foot-and-mouth disease						
	Anthrax						
North-Western	Rinderpest	60	...	5	46	...	9
	Foot-and-mouth disease	222†	...	207	15	...	...
	Anthrax	...	...	...	...	...	...
	Rabies (a bull)	1	..	...	...	...	1
North-Central	Rinderpest	6458	385	1063	5155	67	173
	Foot-and-mouth disease	...	...	...	...	...	...
	Anthrax	...	...	...	...	...	...
Uva	Rinderpest	...	...	...	..	...	...
	Foot-and-mouth disease	6 Outbreaks.				...	
	Anthrax	...	...	...	...	...	...
	Rabies (Dogs)	...	...	...	...		...
Sabaragamuwa	Rinderpest	...	...	..	...	...	...
	Foot-and-mouth disease	526	...	519	7	...	...
	Anthrax	..	...	...	...	...	...
	Piroplasmosis	4	...	4	...	...	...
	Haemorrhagic Septicaemia	78	...	12	66	...	...
	Rabies (Dogs)	1	...	...	...	...	1

* 50 cases occurred among Goats.

† 21 cases occurred among Goats.

G. V. S. Office,
Colombo, 10th December, 1932.

MARTIN WIJAYANAYAKA,
Acting Govt. Veterinary Surgeon.

METEOROLOGICAL REPORT

NOVEMBER, 1932

Station	Temperature				Humidity		Amount of Cloud	Rainfall		
	Mean Maximum	Difference from Average	Mean Minimum	Difference from Average	Day	Night (from Minimum)		Amount	No. of Rainy Days	Difference from Average
	°	°	°	°	%	%		Inches		Inches
Colombo -	84·0	− 1·4	73·9	+ 0·1	80	93	5·5	14·60	23	+ 2·84
Puttalam -	84·0	− 1·2	74·0	+ 0·4	81	93	6·3	11·39	15	+ 1·30
Mannar -	83·8	− 1·3	75·4	− 0·2	80	91	7·2	11·01	14	+ 0·86
Jaffna -	83·0	− 0.3	75·0	+ 0·4	83	90	6·4	31·43	15	+ 16·76
Trincomalee -	83·5	+ 0·1	74·2	− 0·7	80	90	5·8	14·54	18	+ 0·43
Batticaloa -	84·8	+ 0·7	74·3	− 0·1	78	90	4·7	7·46	17	− 6·05
Hambantota -	84·7	− 0·6	74·2	+ 0·4	77	90	5·6	7·94	17	+ 0·96
Galle -	82·3	− 1·5	74·5	+ 0·5	84	93	6·6	13·85	21	+ 2·38
Ratnapura -	85·9	− 2·2	72·5	− 0·1	82	95	7·8	13·08	23	− 1·33
A'pura -	84·6	− 1·1	72·3	− 0·4	79	93	8·3	10·72	20	+ 0·02
Kurunegala -	85·5	− 2·0	72·4	− 0·1	79	95	8·5	9·40	20	− 2·27
Kandy -	81·8	− 1·8	67·9	− 0·7	78	95	7·4	12·50	23	+ 1·99
Badulla -	78·8	− 0·5	65·6	− 0·4	80	97	7·0	7·21	19	− 3·65
Diyatalawa -	74·8	+ 0·8	60·6	+ 0·1	80	94	7·4	10·70	22	+ 0·58
Hakgala -	67·6	− 1·5	55·4	+ 0·2	88	94	7·4	8·67	23	− 3·47
N'Eliya -	67·0	− 1·8	52·8	+ 1·0	80	91	7·6	8·11	26	− 1·03

The rainfall of November was above average over the greater part of the Island. It was particularly heavy in the north of the Island, where several stations recorded excesses of over 15 inches for the month and more than one station over 20 inches. The only other area where an appreciable number of stations recorded excesses of over 5 inches is situated on the western slopes of the central hills. At the majority of stations, however, only slight excesses were registered.

Only two stations, Koslande and Kirimutty, recorded deficits of over 10 inches. Small deficits were common in the east and south-east of the Island, though even here a number of stations recorded slight excesses.

There were more than 50 daily falls reported of over 5 inches and 11 falls of over 10 inches in a rainfall day. The majority of these occurred between the 22nd and the 25th.

The Island came under the influence of two distinct depressions that formed in the Bay of Bengal during the month. None of these came within 100 miles of the Island, but they developed into fairly severe cyclonic storms and exerted considerable influence over the weather. The first of these formed about 200 miles to the north-east of Ceylon and moved in a north-westerly direction causing fairly heavy rainfall over the Island on the 10th. The second formed on the 22nd to the east-south-east of the Island and moving in a north-westerly direction caused heavy rainfall over the Island on the 23rd and 24th.

Thunderstorm activity too was fairly pronounced during the month and accounted for most of the rain during the first and third weeks.

Day temperatures were almost consistently below average, while night temperatures were, on the whole, about average. Humidity, particuarly by day, was above normal.

Winds were generally westerly during the month and above average strength in nearly every case.

D. T. E. DASSANAYAKE.
Actg. Supdt., Observatory.

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